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PEDICLED PERICRANIAL GRAFTS FOR THE REPAIR OF DURAL TEARS IN THE ANTERIOR FOSSA OF THE SKULL

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SYRACUSE, N. Y.

BASAL SKULL fractures in the posterior wall of the frontal sinuses, roof of the ethmoid cells or in the cribriform plate are frequently associated with an overlying tear in the dura mater which often leads to abscess of the brain or to meningitis. Reliable criteria of a torn dura overlying such a fracture following a closed injury of the head are: early meningitis, cerebrospinal rhinorrhea or intracranial aerocele. Signs suggestive of such a tear following a blow to the head are: complete anosmia in either nostril, a profuse nosebleed or a roentgenogram demonstrating a fracture in the anterior fossa. In cases of penetrating wounds of the skull, study of the external wounds, together with roentgenographic demonstration of the missile and its trailing bone fragments, will indicate whether there is a dural defect in the dangerous portion of the anterior fossa. The reasons for formal repair of the dura in this region have been presented by Calvert [1] and Cairns.[2] However, the number of cases in which a major cranial operation will be performed purely to prevent intracranial infection will probably diminish since the advent of penicillin. German [3] has recently summarized the various technics used for dural repair in the anterior fossa. There is here presented an original method of performing this operation with pericranium from the squamous portion of the frontal bone. This method allows the dural graft to retain its own blood supply, which makes survival more prompt, especially in the presence of bacteria, and utilizes tissues available within the operative field.

* Formerly Major in the Medical Corps of the Army of the United States; at present assistant professor of clinical surgery (neurosurgery) in the Syracuse University College of Medicine.

1. Calvert, C. A.: Injuries of the Frontal and Ethmoidal Sinuses, Proc. Roy. Soc. Med. **35**:805-809 (Oct.) 1942.

2. Cairns, H.: Injuries of the Frontal and Ethmoidal Sinuses, Proc. Roy. Soc. Med. **35**:809-810 (Oct.) 1942.

3. German, W. J.: Cerebrospinal Rhinorrhea: Surgical Repair, J. Neurosurg. **1**:60-66 (Jan.) 1944.

STANDARD METHOD

The patient is supine, and the frontal and temporal areas are prepared for operation. The subgaleal tissues of the entire frontal region are infiltrated with fluid, saline solution or a local anesthetic. A transcoronal incision is made from the anterior temporal region on one side to that on the other. The skin and galea aponeurotica are reflected forward well over the supraorbital region, while the knife blade is directed against the galea. Thus, the pericranium over the squamous portion of the frontal bone and the anterior portion of the temporal fascia on each side are revealed under the subgaleal connective tissue. From these structures the pedicled graft will be formed, and they are stripped off the skull and temporal muscles as a second apron, lying on top of the galeal apron and likewise attached to the supraorbital ridges. A frontotemporal osteoplastic flap, usually on the right side, is fashioned to extend across the midline and to hinge on the anterior

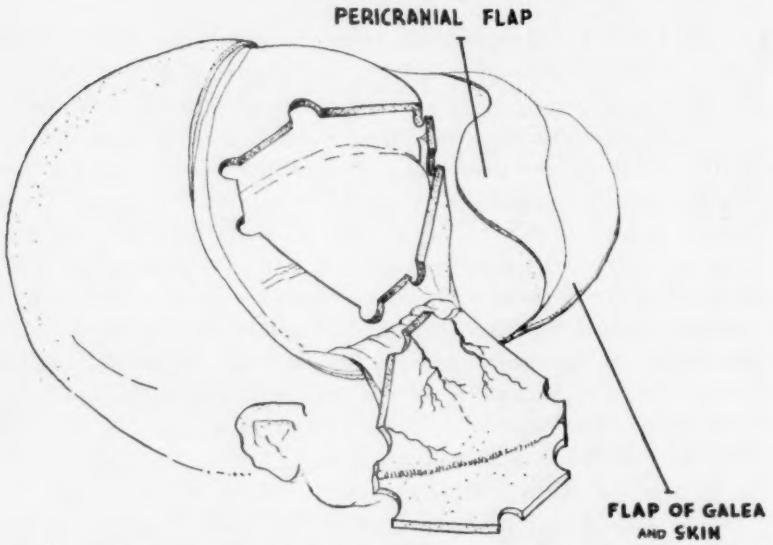

Fig. 1.—Technic of preparing the pedicled pericranial graft for use in the anterior fossa.

portion of the temporal muscle (fig. 1). The anterior fossa is explored extradurally and the dural defect clearly visualized. Débridement of the brain, if necessary, is carried out. The pedicled graft is then tucked in between the dura and the anterior fossa so that it extends well beyond the dural defect. Sutures are usually unnecessary, because the weight of the brain holds the graft in place, but they may be used, especially at the base of the graft to prevent its displacement. The bone flap is replaced and fixed with sutures so that there is no pressure on the pedicle of the graft. The scalp is closed in the usual manner and without drainage.

The technic just described may be considered the standard procedure, and its use is illustrated in the following case.

CASE 1.—A naval officer suffered a blunt injury of the head following the sinking of his vessel off the Normandy coast on June 6, 1944. He was unconscious for several hours and was admitted to a fixed hospital in England under my care

on June 9. At this time he was stuporous, responding to pain but not to noise. There was a linear laceration 2 cm. long in the middle of the forehead, and moderate proptosis of the conjunctiva of each eye. The ocular fundi were normal. Stereoscopic roentgenographic studies of the skull (including the oblique views used for study of the optic foramens) revealed extensive fracture of the anterior fossa of the skull on both sides of the midline. The patient was treated supportively and with penicillin and sulfadiazine. After twenty-four hours the stupor lessened, but there was persistent drowsiness, as well as disorientation. The pupils responded to light for the first time on June 11. On June 15 the standard procedure just described was performed. Exploration of the anterior fossae revealed the fractures previously recognized in the roentgenographic films and also a jagged dural tear 3 cm. long over the medial aspect of the right frontal lobe, from which extruded necrotic cerebral tissue. Nonhemolytic Staphylococcus albus and Micrococcus tetragenus were later cultured from this tissue. The periosteal flap was tucked down into the anterior fossa after some of its attachment to the left supraorbital region had been freed and the frontal crest and the crista galli rongeured away. There remained a broad firm attachment on the right side which extended across the midline and covered over the apex of the left frontal sinus, which had been entered when the craniotomy was made. The periosteal flap extended halfway back along the cribriform plate; thus it reached beyond the fracture lines and the dural tear. The bone flap was fixed with two sutures in such a way that the base of the graft was not pinched. Convalescence was uneventful, and the patient gradually regained his mental clarity. When he was discharged from my care on July 17, the only residual neural defect was partial bitemporal hemianopsia.

The standard procedure has been employed in 4 other cases—all with missiles penetrating the dura where the latter overlies the nose or a paranasal sinus. No complication resulted in any of these cases except 1 in which Bacillus coli meningitis set in but in which recovery eventually resulted.

VARIATIONS OF METHOD

The method described is easily adaptable to various special situations which may arise. Three of these, illustrated in the following cases, are: in case 2, the repair of two dural defects—one over the convexity of the frontal lobe and the other in the base—by dividing the periosteal flap in two; in case 3, the avoidance of a bone flap in the event of a large enough osseous defect in the supraorbital region; in case 4, the repair of a large defect of bone and dura in the region of the cribiform plate by hinging the periosteal flap on the side and using it as a hammock to help support the medial halves of both frontal lobes.

CASE 2.—A soldier suffered a penetrating wound of the skull in France on June 23, 1944. A fragment of an 88 mm. shell about 2 by 1 by 1 cm. had penetrated the middle of his forehead and had come to rest in the right temporal muscle. Débridement and suture of the scalp at the site of entry of the fragment had been performed at a forward hospital. The patient came under my care on July 20 and complained of progressively severe headaches. At this time the scalp wound was healed, the shell fragment was palpable in the right temporal region and the general neurologic examination gave essentially normal results.

Roentgenograms (fig. 2) revealed a comminuted fracture of the right frontal and parietal bones, with numerous bone fragments lying in the frontal lobe.

On July 25 the patient underwent craniotomy with removal of the foreign body, débridement of the brain and repair of two dural defects. Through a coronal incision the skin and galea were reflected forward as one layer and the pericranium as a separate layer. The skull defect provided a right frontal osteoplastic flap. The shell fragment was removed where it lay within the brain and the skull defect. There was a brownish epidural clot, 3 by 1 by 0.5 cm. There were three lacerations of the dura: the anterior was transverse, 6 by 1 cm., and extended across the midline from the right to the left frontal pole; in the course of exposing it the superior sagittal sinus had to be ligated in the third centimeter of its course. The posterior dural defect was 4 by 2 cm. in the right temporal

Fig. 2 (case 2).—Roentgenogram demonstrating the fracture of the skull and the retained shell fragment.

region where the shell fragment came to rest. These two defects, through which pulpal brain extruded, were made continuous by cutting dura and then cortex between the two. All necrotic brain and retained bone fragments were removed, and bacterial cultures of them revealed a nonhemolytic streptococcus. Although it had not been recognized in preoperative films, there was an extensive fracture of the posterior wall of the right frontal sinus, also a small fracture in the roof of the right orbit. The third dural defect was in the sagittal plane, about 3 cm. long, and just above the crista galli. The periosteal flap, which hung from the supraorbital ridges like an apron, was divided by making a semicircular cut in it parallel to and 2 cm. from its free edge. The inner flap was similar in shape to the original but smaller, and was tucked inward over the right anterior fossa so as to seal thoroughly the linear tear in the dura just above the crista galli as

well as to shut off the right frontal sinus from the cranial cavity. The outer periosteal flap, which was shaped like a rainbow and which remained attached at both ends, was incorporated into the large dural defect on the convexity of the brain with interrupted silk sutures at intervals of about 6 mm. Thus a water-tight closure was effected. The dead space between the two periosteal grafts was obliterated by additional rows of interrupted fine silk sutures. This had the effect of increasing the subdural space in front of the right frontal lobe. The bone flap and scalp were closed in the usual manner. Convalescence was uneventful and the wound healed by primary intention. The patient had made a complete clinical recovery when he was discharged from the hospital fifty-three days after operation.

CASE 3.—A soldier was wounded in Normandy on June 9, 1944. The missile was a large shell fragment 15 by 4 by 4 cm. which penetrated the right antrum and orbit and came to rest with its upper end in the right anterior fossa of the skull (fig. 3*A*). On admission to a forward hospital on the evening of June 10 there was evidence of early Bacillus pyocyaneus (Pseudomonas aeruginosa) infec-

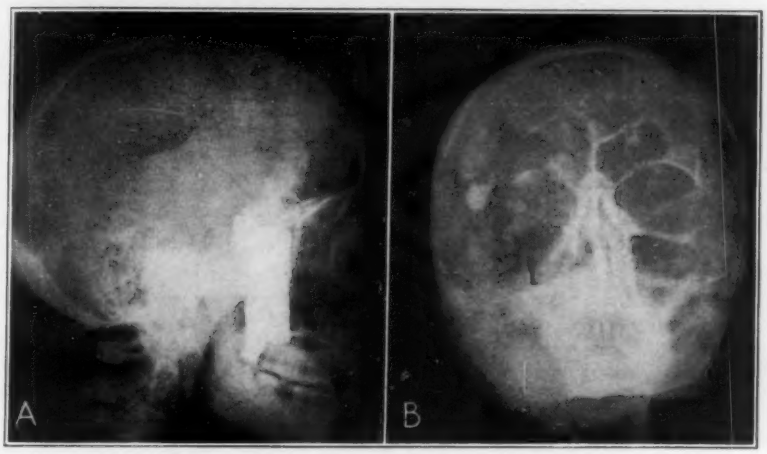

Fig. 3 (case 3).—*A*, roentgenogram made in a forward hospital, demonstrating a large metallic foreign body extending from the maxilla to the anterior fossa. *B*, roentgenogram showing the defect in the roof of the orbit and supraorbital region after removal of the foreign body.

tion of the gaping wound of the right orbit and antrum. The right frontal region was depressed, wth movable bone fragments, and the right temporal region bulged outward. Sulfadiazine and penicillin were administered. The huge foreign body was removed on June 11. The patient was irrational for a few days but began taking fluids by mouth on June 14. He was admitted to my care at a general hospital in England on June 24. On this date he was still somewhat disoriented and confused. He was able to smell cigarets and did not have a stiff neck. A profuse seropurulent fluid was draining from the gaping remains of the right orbit. Further roentgen films (fig. 3*B*) revealed a comminuted fracture of the entire right orbit, the base of the right frontal sinus and the adjacent supraorbital and temporal portions of the frontal bone as well as retained bone fragments in the base of the right frontal lobe of the brain. The huge missile had penetrated the right antrum and had been driven upward through the right orbit, utterly destroying the eyeball, and had driven part of the roof of the orbit upward into the

base of the right cerebral hemisphere. It had also turned the lateral part of the roof of the orbit and associated external angular process upward into the temporal fossa. Furthermore, it had fragmented the medial aspect of the roof of the orbit and the roof of the right sphenoid sinus.

Débridement of the right orbital roof, evacuation of the superficial abscess at the base of the right frontal lobe of the brain, and repair of the dural defect were carried out on June 25. By means of a large transcoronal incision the frontal portion of the skin of the scalp with the subjacent galea was reflected forward as a single layer. The underlying pericranium was also reflected forward but as a separate layer. After the fragmented portion of the roof of the orbit had been removed, there were revealed two dural tears under the base of the frontal lobe: one 2 by 1 cm. and the other 4 by 1 cm. There was about 30 cc. of pus surrounding a bone fragment which was projecting into the brain at one of these dural defects. An immediate smear revealed many pus cells but no organisms. Cultures of this later disclosed no growth. Penicillin and sulfanilamide powder were placed in the residual bed of the brain. The large periosteal flap, which measured 18 by 15 cm., was freed except at the lateral half of the right supraorbital region. It was insinuated into the place that had been occupied by the roof and the medial wall of the orbit, i. e., between the periorbita and the dura. The dural defects were thus fully surrounded and supported. The lateral aspect of the right frontal sinus was excluded from the dural defects by careful suturing of the medial edge of the periosteal flap to the dura near the midline. The scalp was closed in layers without drainage.

Convalescence was uneventful, and the scalp wound healed by primary intention. Considerable matter continued to drain from the wound of the orbit and maxillary antrum. By June 30 the patient's confusion was lessening and he was walking about, attending to his own needs. He was discharged from the hospital thirty days after operation, essentially well except for needing plastic repair of the tissues around the right orbit.

CASE 4.—The patient came under my care in the evening of May 25, 1944, one hour after the explosion of a 6 foot high rubber tire which he had been repairing. He had suffered a severe wound of the head and a fracture of the shaft of the left femur. On arrival he was drowsy and incoherent. His pulse rate and blood pressure were normal. Just below the eyebrows there was a straight horizontal incised wound 10 cm. long across the midline and symmetrically disposed. The wound gaped 2 cm. and was bleeding moderately when the bandage was removed. There were marked ecchymosis and edema of both upper lids and hemorrhagic chemosis of the conjunctiva of each eye. There was no perception of light and no pupillary reflex in the left eye. Some useful vision was present in the right eye. The simple complete supracondylar fracture of the femur was temporarily treated with a Thomas splint. Emergency roentgenograms of the skull revealed in the lateral view fracture of the anterior fossa with displacement of fragments and in the posteroanterior view comminution of the root of the nose and both supraorbital ridges.

Two and a half hours after the wounding the patient was conscious, cooperative and in moderate pain. A transfusion of blood was given because of loss of blood. Under local anesthesia the wound was irrigated and loose fragments of the frontal bone were removed. The wound resembled the cut of an ax, passing immediately caudal to the eyebrows and in the plane of the cribriform plate. The crista galli had been cut off at its root and pushed upward into the brain. At this point there was an anteroposterior linear midline laceration of the dura, 3 cm. long, out of which the crista was picked as a loose fragment. A few cortical vessels

were caught with silver clips, which are visible in subsequent roentgenograms (fig. 4*A*). The rent in the dura was sutured with black silk as far as could be easily visualized, but thorough exploration of the dura was not attempted at this time. Comminuted fragments of bone representing the cribriform plate, the roofs of the orbits, the walls of the ethmoid cells and the floor of each frontal sinus were removed. The scalp was closed with interrupted silk sutures. Sulfadiazine was administered as a prophylaxis against meningitis. Bacterial cultures of the wound revealed a nonhemolytic Staph. albus and a hemolytic streptococcus.

On the following day he spat up a small piece of rubber inner tubing which presumably had been driven into the nasopharynx at the time of the explosion. On May 27 Kirschner wire traction was applied to the femoral condyles on a suspended Thomas frame. For two hours after this procedure the patient was confused and disoriented, a state attributed to fat embolism. At no time was there nuchal rigidity. On May 30 the ocular fundi revealed dilatation of the retinal veins, along which there were flame-shaped hemorrhages. Check roentgen films

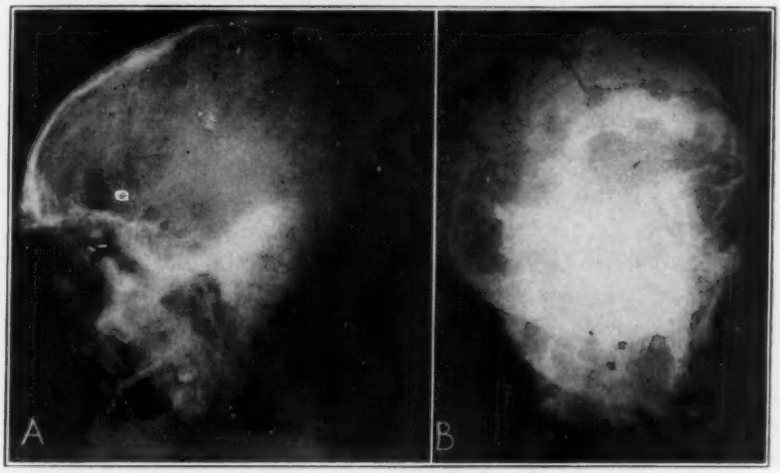

Fig. 4 (case 4).—*A*, roentgenogram revealing the defect in the supraorbital region after débridement and suture of the laceration of the scalp but before definitive dural repair. The silver clips are on cortical vessels within the dural defect at the crista galli. *B*, postoperative roentgenogram showing the left optic foramen and the huge defect of the anterior fossa.

of the femur revealed the fragment to be in good position, and the patient's general condition continued to improve.

On June 6 the definitive dural repair was carried out. The skin and galea were reflected through a coronal incision. The pericranium, subgaleal connective tissue and right temporal fascia formed a second apron. The frontal attachment of this pericranial graft to the supraorbital regions had been severed by the original wound. However, the graft was left attached and hinged on the left temporal ridge. It was rectangular, about 20 cm. from side to side and 10 cm. from front to back. A large bifrontal osteoplastic bone flap was made in such a way as to leave a bridge of bone 1 cm. wide in the supraorbital region which included the remains of the small frontal sinuses. The bone flap was hinged on the right temporal muscle. The anterior fossa of the skull was approached extradurally, by gentle elevation of the frontal lobes, but, as usual when the dura is torn off

the cribriform plate, additional bleeding resulted. The osseous defect in the anterior fossa was then seen to include the entire cribriform plate, the roof of most of the ethmoid cells, the medial half of the roof of the right orbit and the medial third of the roof of the left orbit (fig. 4 *B*). A piece of necrotic brain tissue from the under surface of the frontal lobe was sent for bacterial culture, which later revealed Staph. albus and Streptococcus viridans. When all the dura was freed from the cribriform plate and roof of the sphenoid sinuses posterior to it (leaving a dural defect about 2 by 4 cm. directly over the site of the cribriform plate), the frontal lobes in their dural envelope were elevated enough so that the periosteal flap, which had been left firmly attached to the left temporal fascia, could be tucked under the dura over the entire anterior fossa of the skull, thus amply extending beyond the dural defect and the defects of both orbits. This manipulation caused a swelling of the frontal lobes which held the graft firmly in place. The bone flap was replaced and fixed in such a way that it would not pinch on the base of the graft. The scalp was closed in layers without drainage.

Convalescence was uneventful and the wound healed by primary intention. At the time of dismissal from my care, thirty-nine days after the operation, the only residual neural defects were amaurosis of the left eye and bilateral anosmia. Seven months after operation the patient was earning his own living and had only a slight limp as a result of the fracture of the femur.

COMMENT

In a previous paper [4] I discussed the importance of watertight closure of dural defects occurring in either the vault or the base of the skull, and presented an original method of utilizing pedicled grafts of pericranium and temporal fascia for this purpose. Such closure of the dura is a barrier in two senses: It excludes blood and bacteria from the central nervous system, and it restrains the cerebrospinal fluid and the brain within their normal confines. The present paper indicates a method of utilizing such grafts for dural defects in the anterior fossa of the skull. The recommended technic not only provides a method of repairing dural defects in a location in which a dural defect is most frequently followed by intracranial sepsis but also seals off frontal and ethmoid cells from the cranial cavity. The procedure may be adapted not only to the ordinary types of fracture of the anterior fossa but also to certain larger or more complicated defects, three of which are illustrated. It is especially noteworthy that in each case the flap healed directly despite the exposure of portions of it to the cavity of the nose and the paranasal sinuses.

SUMMARY

There is presented a method of repairing dural tears in the anterior fossa of the skull by the use of pedicled grafts of the frontal pericranium which also seal off the frontal and ethmoid cells.

4. Ecker, A. D.: Tight Dural Closure with Pedicled Graft in Wounds of the Brain, J. Neurosurg. **2**:384-390 (Sept.) 1945.

OTOLARYNGOLOGIC EXPERIENCES IN THE PHILIPPINES

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CHICAGO

THE PURPOSE of this report is to summarize briefly some interesting aspects of the otolaryngologic experiences encountered during the Philippine Campaign of World War II. Emphasis will be on personal impressions rather than on statistics, with chief consideration directed to (*a*) traumatic conditions, (*b*) infectious diseases and (*c*) miscellaneous topics. The clinical material was cleared through a large general hospital in which nearly 25,000 patients were treated in the ten month period of the hospital's active service. It should be borne in mind that the exigencies of war resulting from such factors as unpredictable rates of admission and disposition, physical working conditions and shortages of personnel and equipment were all too frequently responsible for shortcomings in scientific endeavor.

TRAUMATIC CONDITIONS

Bullets and Shrapnel in the Nasal Accessory Sinuses.—The diagnosis of bullet or shrapnel lodged in an accessory nasal sinus presented no problem, nor did the surgical exposure of and approach to these foreign bodies. The actual delivery of the fragments was complicated by the manner in which they were embedded in adjacent bone, considerable force often being required for their extrication. Patient manipulation was necessary in dealing with jagged margins which projected from the maxillary sinus into the pterygomaxillary fossa and orbit (fig. 1). The optic nerve, carotid artery and cribriform plate were not infrequently endangered by sphenoethmoid foreign bodies (fig. 2). In 2 instances the optic nerve had been damaged by small fragments which produced negligible external wounds and no other symptoms. Decisions as to the necessity for removal demanded individualization in each case.

Intratracheal administration of the anesthetic agent was found to be most satisfactory, providing greater accessibility, relaxation, and ease of control of hemorrhage. Extensive intranasal synechiae following penetrating missiles were usually dealt with by secondary intranasal operations with the patient under local anesthesia.

Candidate's thesis for regular membership in the Chicago Laryngological and Otological Society, read before that group April 1, 1946.

Involvement of nerve tracts with subsequent post-traumatic neuritis frequently required injections of procaine hydrochloride or alcohol for relief of pain. Particularly gratifying results were obtained from these

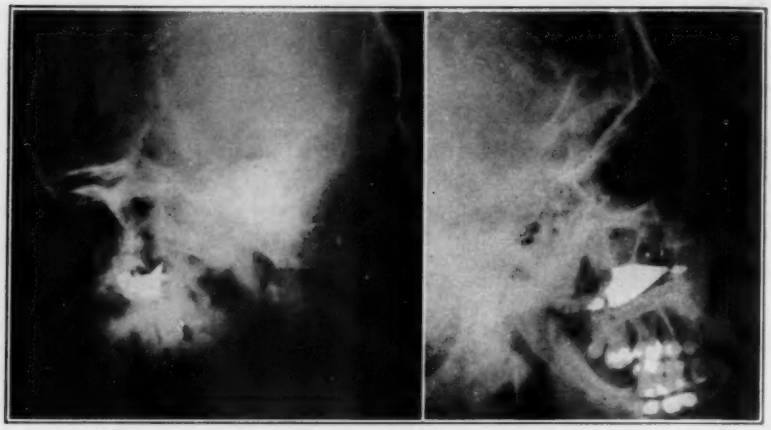

Fig. 1.—Left: jagged shrapnel in the maxillary sinus. Right: bullet in the maxillary sinus.

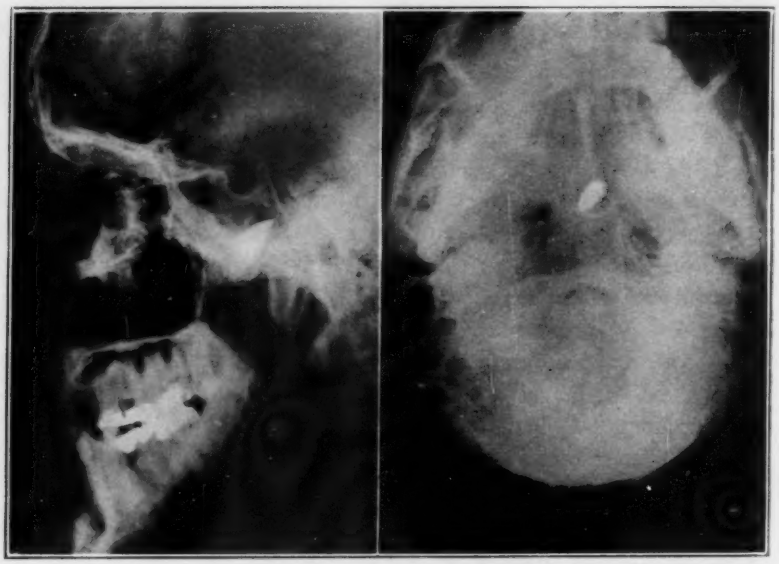

Fig. 2.—Left: bullet embedded in the floor of the sphenoid sinus, lateral view. Right: basal view of the bullet in the left sphenoid sinus.

procedures with the infraorbital nerves, which were by far the most often affected.

Fractures of the Zygomatic Arch.—This particular injury was rather common but only occasionally followed wounds incurred in battle. (In

1 case the arch was fractured by a bullet which creased the prominence in linear fashion but caused no further damage.) The majority of fractures of the malar bone were the result of airplane and vehicle accidents or of direct blows from fists or other objects. The average depressed fracture of the malar bone was best demonstrated by the submentovertical roentgenographic view and was reduced by the temporal approach of Gillies (fig. 3). Various other technics may be used in exceptional cases, but the approach through a clean field and the ease of manipulation in the Gillies method proved extremely satisfactory.

Blast Concussion Injuries of the Ears.—A series of 200 cases of blast injury of the ears presented an interesting opportunity of studying the early gross effects of blasts on the middle and inner ear.

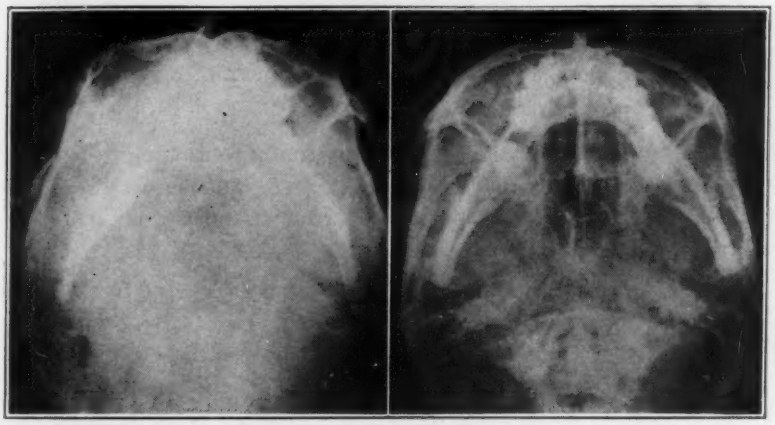

Fig. 3.—Left: depressed fracture of the right zygomatic arch. Right: position of the arch after reduction by Gillies' method.

Explosions of land mines, aerial bombs, mortar and artillery shells and ammunition dumps and direct injuries of the head accounted for the majority of cases in this group.

There were two limitations to this undertaking. One was the unavailability of an audiometer, and the second was the inadequate follow-up occasioned by the required evacuation of those unfit for further duty. All determinations of hearing were made by the same observer employing voice and tuning fork tests in a relatively quiet enclosed room 20 by 6 feet (6 by 2 meters) in dimensions. The findings in the 100 cases are summarized in the accompanying table.

On one occasion, casualties from a billet adjacent to an exploding ammunition dump were admitted within a few minutes after the accident. Aural effects from the blast were predominant. Fifteen of the 30 wounded were given chemotherapy in order to determine its effect,

if any, on the incidence of otitis media following traumatic rupture of the tympanic membrane. In this small series there was no evidence that sulfonamide therapy had any value in preventing the development of suppuration in the middle ear following concussive rupture of the tympanic membrane.

The average healing time for suppurative otitis media developing after blast injury ranged from three to four weeks in those cases in

Summary of Auditory Findings in One Hundred Early Cases of Blast Concussion of the Ears

Type of Injury	Cases	Hearing on Basis of 15 Feet (4.5 Meters) (Low Spoken Voice)
Tympanic laceration	7	15
Tympanic rupture		
Uncomplicated	17	9.7
Suppurative	46	6.6
Damage of inner ear	44	
Unilateral	24	4.6
Bilateral	20	2.3

which it might be assumed that careful routine cleansing, local medication and attention to any disease of the nose and sinuses were faithfully pursued. One was frequently amazed at the sizable central perforation which eventually closed entirely.

Wounds of the Pharynx and the Larynx.—The extreme vulnerability of the recurrent laryngeal nerves was noteworthy. There were, of course, many wounds of the neck which involved these nerves directly, but it was not at all unusual to observe paralysis of the vocal cord occurring on the side opposite to contused injuries, accompanying superficial wounds, or following trauma of the head in which no other cranial nerves were affected. Preexisting paralysis might have been suspected had it not been for the presenting symptom of recent hoarseness.

One of the most spectacular cases was that of a soldier who had been wounded by a bullet of small caliber which entered the neck laterally just above the thyroid cartilage, traversed the hypopharynx and emerged at a comparable point on the opposite side of the neck. Each lateral wall of the pharynx showed where the bullet had passed through. There was practically no local reaction, no important structures were injured and the soldier's only complaint was slight dysphagia.

Cicatricial webs of the larynx presented the problem of patient excision and repeated dilation until an adequate lumen could be reestablished.

INFECTIOUS DISEASES

Despite relatively slight variations of mean temperature, the rates of incidence of the common cold, acute tonsillitis and diphtheria were high.

One might justifiably speculate on an enhancement of the transmission of these infectious diseases by air travel, with personnel leaving winter epidemics in temperate zones and arriving in the tropics in twelve to thirty-six hours. Poliomyelitis and virus infections of the central nervous system produced otolaryngologic problems. As might be expected, fusospirochetal conditions of the mouth and pharynx were common.

Deafness in Scrub Typhus (Tsutsugamushi Fever).—Although only 20 soldiers with scrub typhus and aural symptoms were observed in New Guinea, the results were of sufficient interest to be included in this report.

Impaired hearing was usually noted by the patient on the second or third day of the disease. Tinnitus was mild, if present at all, while vertigo was entirely absent. The defects of hearing were found to be either unilateral or bilateral and often profound, being exclusively of the perceptive type. Diplacusis was frequently discovered in routine tuning fork tests.

Subsidence of aural symptoms began spontaneously between the tenth and the fourteenth day of the illness, with complete return of function evident by the fourth to the sixth week. No residual gross defects were found.

The symptoms and clinical findings are perhaps best explained on the basis of perivascular infiltration or edema affecting the cochlear division of the acoustic nerve. There were no fatal cases in this group.

The Mycoses.—(*a*) External Otitis: This summary will not add to the already voluminous reports on the subject. It is my opinion that causative agents may be found among a considerable variety of fungi and bacteria. Prophylaxis, accomplished by issuing directives on the proper care of the ears in the tropics, was the most effective means of control. In the active treatment, meticulous daily cleansing of the auditory canals by trained personnel was fully as efficient as any specific local medication in the majority of cases. (An exception was the application of fungicides in early cases of external otitis proved to be caused by fungi.) Where cellulitis of the wall of the auditory canal complicated infection, systemic chemotherapy and use of antibiotics were found to be necessary adjuncts to local measures in order to expedite healing and the soldier's return to duty. Finally, infection extending through the tympanic membrane into the middle ear was observed on a number of occasions.

(*b*) Pulmonary Mycoses: Diagnoses of pulmonary actinomycosis and moniliasis were made in 1 and 3 instances, respectively, following laboratory studies of secretions removed on repeated bronchoscopic examination.

Tuberculosis and Yaws.—The prevalence of these infections among the native populace provided interesting opportunities for the study of both early and advanced lesions about the head and neck (fig. 4).

MISCELLANEOUS

Allergic States.—It was evident that many allergic persons experienced an increase of the severity of their symptoms in the tropics. The intense humidity and the abundant tropical flora were thought to be precipitating factors. In many soldiers hay fever and asthmatic symptoms developed for the first time. Others with a background of previous mild allergic rhinitis and sinusitis became ineffective and required evacuation. The striking feature in these cases, however, was the frequency with which dermatitis, external otitis and allergic rhinitis, sinusitis or bronchitis appeared in the same person.

Fig. 4.—Primary lesion of yaws involving the inner canthus of the right eye.

Fig 5.—Adamantinoma of the mandible.

Salivary Calculi.—Calculi were often seen in Wharton's duct. When these stones lay at or near the junction of the submaxillary gland and the duct, the most important single aid to intraoral surgical removal was found to be extrinsic pressure by an assistant. Only rarely did removal of the gland seem indicated in these cases.

Neoplasms.—Cancers of the upper respiratory tract were rare among army personnel but were seen in the older age groups of the native population. In the latter category a number of bizarre tumors, some benign and some cancerous, proved to be of considerable scientific interest (figs. 5 and 6).

Fig. 6.—Left: huge neurofibroma of the orbit. Right: appearance of the patient after exenteration of the orbit.

Foreign Bodies in the Upper Passages.—The all too infrequent consignments of fowl from across the sea were often followed by calls for the endoscopist to remove chicken bones from the upper part of the esophagus. Introduction of foreign objects into the mouth did not seem to be as common a practice among natives as it is in more "civilized" countries. As a result, native children apparently only rarely aspirated or swallowed foreign bodies.

Wound Healing.—There were no obvious deleterious effects of the tropical climate on healing of the wounds. Despite marked dietary differences between Americans and natives, no deficiencies were noted in the healing capacity of the latter group.

SUMMARY

An outline of otolaryngologic experiences in the Philippine Campaign of World War II is presented. Traumatic states, infectious diseases and miscellaneous topics are included. Among the variety of subjects briefly covered are foreign bodies in the nasal sinuses, fractures of the zygomatic arch, blast concussion injuries of the ears, wounds of the pharynx and the larynx, the mycoses and deafness in scrub typhus.

122 South Michigan Avenue.

PENTOTHAL SODIUM AND A COMBINATION OF PENTOTHAL SODIUM AND CURARE AS AN ANESTHETIC FOR TONSILLECTOMY

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ANCON, CANAL ZONE

THE SERIES of tonsillectomies to be presented have been divided into two groups: one with pentothal sodium, and the other with curare and pentothal sodium, being used as the anesthetic. The cases in which pentothal sodium was used, of which there are 25, will be referred to as group 1. Accordingly, the 22 cases in which curare and pentothal sodium was the anesthetic will comprise group 2. In no way do I endeavor to persuade the surgeon that this type of anesthesia surpasses others for this phase of otolaryngologic surgical practice.

Fox and Rochberg [1] and Ritter [2] have reported on the use of pentothal sodium anesthesia for tonsillectomies, with minor variations. Helfman and Morris [3] have used curare with ether and have reported that the results were satisfactory enough for them to adopt the technic permanently. I first got the idea of using pentothal sodium to reduce induction time under that with ether. Then in hopes of reducing the amount of pentothal sodium used and also of diminishing trismus and increasing pharyngeal relaxation I resorted to the addition of a curare preparation (intocostrine solution, Squibb). The pharynx and larynx in all cases except 1 were sprayed with either a 2 per cent solution of butacaine sulfate or a 10 per cent solution of cocaine hydrochloride. Thomas,[4] in using pentothal sodium for operations on the ear, nose and throat injected 6 cc. of 1 per cent solution of larocaine (para-aminobenzoyl-2,dimethyl-3,diethylaminopropanol) hydrochloride directly into the trachea after having applied tetracaine hydrochloride or cocaine hydrochloride to the piriform sinuses. Endotracheal intubation was used in all the cases in my series but 3.

From the Department of Otolaryngology, the Presbyterian Hospital.

1. Fox, S. L., and Rochberg, S.: Anesthesia for Tonsillectomy Induced by Intravenous Administration of Pentothal Sodium, Arch. Otolaryng. **41**:439 (June) 1945

2. Ritter, D.: Pentothal Sodium Anesthesia in General Surgery: A New Method of Combining It with Nitrous Oxide and Oxygen, Anesth. & Analg. **24**: 205 (Oct.) 1945.

3. Helfman, H., and Morris, E. M.: Curare in Adult Tonsillectomy, Anesthesiology **6**:626 (Nov.) 1945.

4. Thomas, G. J.: Pentothal Sodium in Ear, Nose and Throat Surgery, Ann. Otol., Rhin. & Laryng. **52**:35 (March) 1943.

In group 1 a 2.5 per cent solution of pentothal sodium was used throughout. Endotracheal intubation was performed, the nasopharyngeal route being used after a topical anesthetic had been applied. To those patients showing a marked emotional response, 5 to 10 cc, of the solution of pentothal sodium was given before the tube was inserted. Irritation from the tube per se did not cause any spasm of a larynx previously

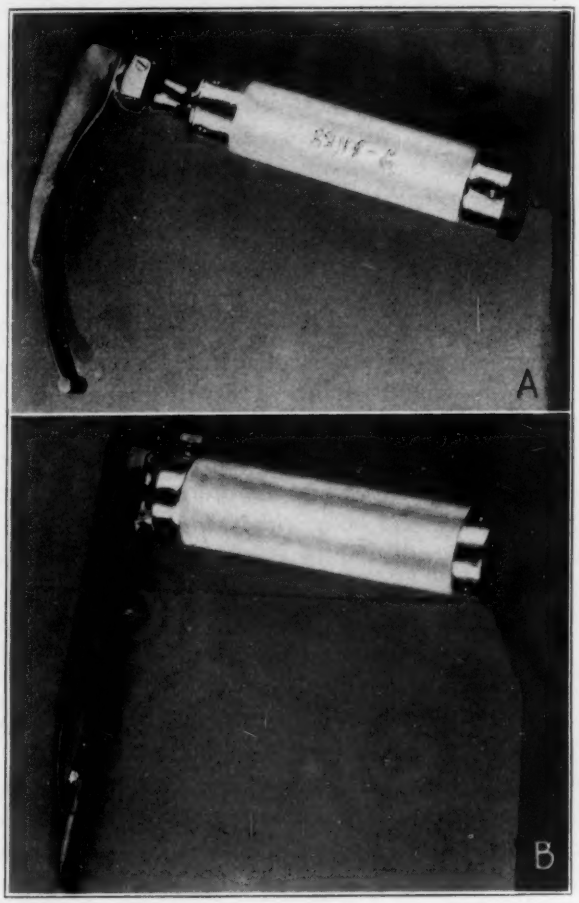

Fig 1.—*A*, MacIntosh laryngoscope. *B*, Wis-Foregger laryngoscope.

sprayed. In the few cases in which blind nasopharyngeal intubation failed, pentothal sodium was administered until the patient was unconscious and relaxed, and the tube was then inserted by the same route or through the mouth and guided by a MacIntosh or a Wis-Foregger laryngoscope (fig. 1). It might be added here that in those cases in which a laryngoscope was used, additional pentothal sodium was necessary to get relaxation of the mandible; often it was necessary to wait an

additional short interval. It was here that it was thought the addition of the curare preparation might prove beneficial.

For those cases in which the curare preparation was used in conjunction with pentothal sodium, 4 cc. of the solution (80 units of the curare preparation) was given intravenously after the pharynx and larynx had been sprayed with a topical anesthetic. This was followed by 5 cc. of 2.5 per cent pentothal sodium. The endotracheal tube was then inserted through the mouth with the aid of the laryngoscope. In no instance was there a spasm of the mandible or the larynx, nor was there any respiratory depression or laryngospasm, before a tube had been inserted. After beginning the tonsillectomy one endeavored to maintain the anesthesia on the curare preparation alone with little if any additional pentothal sodium. Only in 2 of the cases in group 2 was oxygen required or artificial respiration administered by a machine and bag over a period of a few minutes. Respiratory depression with curare could hardly be considered an emergency, as it should be anticipated and prepared for whenever the drug is to be used.

The swallowing reflex was present to a degree inverse to the amount and the thoroughness of the topical anesthetization; however, when present to any degree it did not interfere with the surgical procedure.

Some adenoid tissue was present in a little less than 50 per cent of the cases. This was removed after the tonsils had been dissected and the bleeding controlled, either while the oral tube was in situ or after the nasopharyngeal tube had been withdrawn.

The shoulders in all cases were elevated with a low pillow so that the slope of the posterior part of the pharynx was toward the nasopharynx. This was an added precaution against laryngospasm. The patient was sent to the ward on the back with the face turned to either side and a Connell or similar airway in place.

Patients in group 1 reacted, on the average, in seventy-five minutes, the longest reaction period being one hundred and fifty and the shortest twenty minutes. The postoperative course of these patients proved annoying to the nursing staff mainly because of the effort required to subdue most of them. In an attempt to diminish the postoperative period of somnolence and boisterousness, 0.6 Gm. of caffeine sodium benzoate was given intravenously immediately after the operation. About 10 of the patients of group 1 received this medication, which stimulated respirations and tended to diminish the annoying period somewhat.

The patients of group 2, on the other hand, reacted, on the average, in twenty-five minutes, the longest reaction period being one hundred and twenty and the shortest less than five minutes. With none of these was the postoperative course at all distressing, and after the initial response the patients settled into a long peaceful sleep. Morphine requirements were similar to those in cases in which ether was used.

Vomiting occurred in 3 cases and hemorrhage in 1; the incidence of the latter is assumed to be about the same as for tonsillectomies performed with the patients under ether.

ROUTINE

1. Preoperative medication in all cases consisted in administration of amytal two hours before, most patients receiving 0.2 Gm., and morphine sulfate 0.015 to 0.020 and scopolamine hydrobromide 0.0004 Gm. forty-five minutes before.

2. A 10 per cent solution of cocaine hydrochloride or a 2 per cent solution of butaine sulfate was sprayed to the pharynx and larynx by means of a DeVilbiss no. 36 directional atomizer two or three times at intervals of a few minutes. In addition, the nasal mucosa was sprayed in group 1. Cocaine proved more rapid and thorough, and no reactions were noted.

3. In group 1, blind endotracheal intubation by way of the nasopharyngeal route was attempted. In only a few was the use of the laryngoscope resorted

Comparative Figures of Groups 1 and 2

	Minimum	Average	Maximum
Pentothal sodium, Gm.			
Group 1	0.75	0.96	1.50
Group 2	0.30	0.68	1.12
Curare, mg.			
Group 1	0	0	0
Group 2	40	100	160
Reaction time, min.			
Group 1	20	75	150
Group 2	5	25	120
Age, yr.			
Group 1	13	26	49
Group 2	19	29	40

to for guiding the tube between the vocal cords. This procedure was performed after the patient had been put into deep anesthesia with an initial injection of from 10 to 20 cc. of 2.5 per cent pentothal sodium.

4. Eighty units of the curare preparation (4 cc. of the solution) was given initially in most cases of group 2 followed by 5 cc. of a 2.5 per cent solution of pentothal sodium. The endotracheal tube was then inserted by the oral route with the aid of the MacIntosh or the Wis-Foregger laryngoscope.

5. The mouth gag was put into place, and the operation was started. It might be added that difficulty was often experienced in getting the mouth open in the cases of group 1.

6. In group 1, enough pentothal sodium was given to prevent the patient from reacting, care being taken, however, to avoid respiratory depression. The average amount of pentothal sodium used was 0.96 Gm.—the smallest amount being 0.75 and the largest 1.5 Gm. In group 2 an effort was made to maintain the patient's anesthesia by further intravenous injection of the curare solution rather than by addition of pentothal sodium. When the patient reacted slightly, one or two more cubic centimeters of the curare solution was injected. The average amount of curare administered was 100 mg., with 40 and 160 mg. representing the extremes. It might be added that in the first few cases caution was taken with the curare,

which accounts for the low average dose. The average amount of pentothal sodium in this group was 0.68 Gm., with 1.12 and 0.3 Gm. as the respective maximum and minimum range.

7. Nasopharyngeal endotracheal tubes were removed for adenoidectomy, care having been taken to aspirate secretions collected in the hypopharynx with suction. The tube was left in place in the cases in which it entered the trachea by the oral route. All tubes were removed immediately after operation, provided the respirations were adequate. A Connell or similar airway was inserted.

8. Caffeine sodium benzoate, 0.6 Gm., was injected intravenously through the pentothal sodium needle at the end of operation in the last cases of group 1.

9. Morphine was administered as necessary and fluids as tolerated postoperatively.

COMMENT

The addition of curare, which is not an anesthetic per se, was important in diminishing the amount of pentothal sodium and most helpful in producing relaxation. In no case was 80 mg. of curare, given as an initial dose, sufficient to produce paralysis of the diaphragm before intubation. The trismus was, however, sufficiently reduced to enable intubation with ease via the oral route. In turn, trauma to the nasal mucosa, adenoids and epiglottic structures, sometimes seen when the nasopharyngeal route was used, was eliminated by use of the oral tube.

As was strongly emphasized by the assistant, the profound relaxation of the tongue tended to make depression of this structure much easier; the pharyngeal reflexes were somewhat less with curare.

It has been shown that considerably less pentothal sodium was required in group 2, which, in turn, permitted the patient to react much sooner. It should be added that the period of recovery was relatively quiet, with little or no struggle on the part of the patient.

A consideration which might contraindicate the use of curare is that respiratory depression may frequently occur. If, however, this is anticipated and a gas machine with a bag is kept at hand, artificial respiration can be maintained and the surgical procedure continued uninterrupted. It was found necessary to institute artificial respiration in 2 cases.

The patient in group 1 in whom no local anesthetic was used showed considerable laryngospasm whenever the cords were stimulated before and during intubation. Pharyngeal action was also more marked.

Three patients in group 1 were not intubated, and no difficulty with spasm of the larynx or with pharyngeal movement was noted. It was felt that even though tonsillectomy could well be performed without the tube, it was best to have one in place, not forgetting the tendency for respiratory depression to occur on administration of pentothal sodium and curare.

Regarding the use of the endotracheal tube I feel as others [5] do: Any patient who is apt to vomit and regurgitate should be provided with an

5. Whitacre, R. J., and Fisher, A. J.: Clinical Observations on the Use of Curare in Anesthesia, Anesthesiology **6**:124 (March) 1945.

adequate airway. For the nasal route the Magill type rubber catheter was used. For the oral route the same type but with a shorter tube was satisfactory; or a Latex tube may be used, with embedded metal spiral and inserted on a stilet (fig. 2).

An observation made in the cases of group 1 was that patients frequently became cyanotic regardless of the endotracheal tube and a fair degree of respiratory exchange. This was assumed to be due to bronchospasm, and on that basis 0.0004 Gm. of scopolamine hydrobromide was injected intravenously again just before the anesthetic was administered. Interestingly enough, thereafter no patient with whom this procedure was

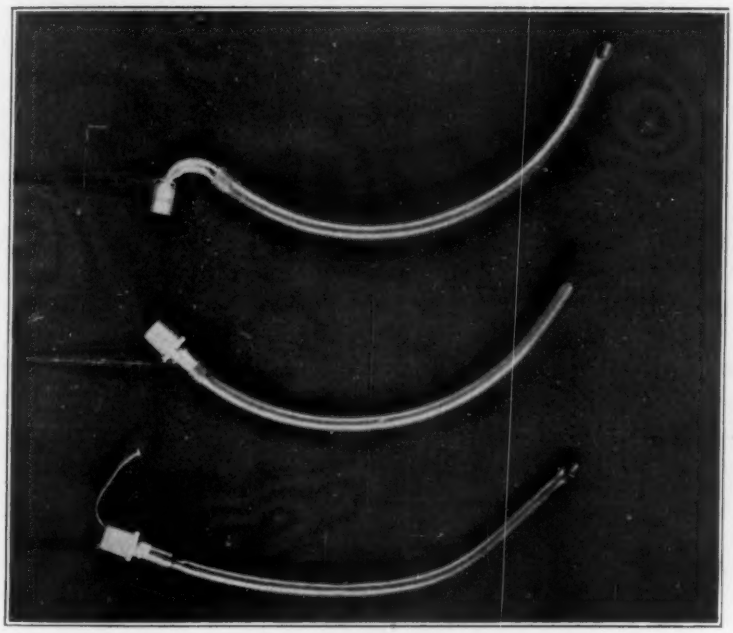

Fig. 2.—Endotracheal tubes.

carried out became cyanotic, the difference being remarkable. Once the cyanosis had appeared, however, the same dose of scopolamine hydrobromide did little to improve the situation.

All tonsils were removed by dissection, and an attempt was made to have the fossae dry when the patient left the operating room.

It is felt that an anesthetist who has had experience with these two drugs in combination and can perform a good endotracheal intubation can produce anesthesia as satisfactory as that obtained by endotracheal administration of ether, with additional helpful relaxation.

Dr. Virginia Apgar, head of the anesthesia department of the Presbyterian Hospital, and Dr. Richter gave invaluable assistance.

INTERRELATIONSHIP OF HYDROGEN ION CONCENTRATION, ELECTROLYTE CONTENTS AND COLLOIDS IN PERMEABILITY OF MEMBRANES

Calcium Sulfathiazole in Nasal Therapy

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IN RECENT years considerable attention has been paid to the question of the hydrogen ion concentrations of nasal secretions as well as to those of solutions used in nasal medication, particularly by Fabricant,[1] Van Alyea, Proetz [2] and others. Interesting studies have been made also on the influence which various drugs have on the ciliary activity of the mucosa of the upper respiratory tract by Lierle and Moore,[3] Proetz [2] and Yates.[4]

However, important as these elements are, they should not be evaluated independently but seen rather in their combined relationship to the permeability of membranes. Thus perfusing fluids of the same hydrogen ion concentration would have quite different effects on the permeability of membranes, depending on the presence of calcium, sodium or potassium ions. To stress the hydrogen ion concentration of a solution without recognition of electrolytic activity would lead to gross misjudgments.

One cannot therefore list therapeutic agents purely by their p_H values and thus decide their relative merits. The degree of ionization, the formation of complexes, the protein-combining properties and the properties of the electrolytes all play so vital a role in the question of equilibrium between the cell colloids, the membrane and the perfusing fluid that the simple determination of p_H is too superficial a basis for any real evaluation. The emphasis placed on ciliary action must also not obscure the physicochemical relationships of the nasal membrane.

The factors influencing the nasal membrane are essentially the same as those influencing the capillary membranes. In fact, the transudation

1. Fabricant, N. D.: Nasal Medication: A Practical Guide, Baltimore, Williams & Wilkins Company, 1942.

2. Proetz, A. W.: Nasal Ciliated Epithelium with Special Reference to Infection and Treatment, J. Laryng. & Otol. **49**:557-569 (Sept.) 1934.

3. Lierle, D. M., and Moore, P. M.: Effects of Drugs on Ciliary Activity of Mucosa of Upper Respiratory Tract, Arch. Otolaryng. **19**:55-65 (Jan.) 1934.

4. Yates, A. L.: Methods of Estimating the Activity of the Ciliated Epithelium Within the Sinuses, in Proetz, A. W.: Essays in Applied Physiology of the Nose, St. Louis, Annals Publishing Company, 1941, p. 29.

of fluid through the capillary walls gives the nasal mucosa its characteristic appearance of turgescence, with the nasal passages obstructed, while the contraction of the arterioles gives it the constricted appearance, with passages free. It therefore behooves one to study the influence of electrolyte contents and hydrogen ion concentrations on capillary permeability. Here the work of Zweifach [5] and that of Chambers and Zweifach [6] are particularly illuminating.

In a previous article on the vascular mechanics of the common cold and allergic rhinitis [6a] I pointed out the relationship of the selective nature of the membranous wall and the factors which force the materials across this barrier. Diffusion through the endothelial membrane is of fluid in bulk, and the structure and the functional efficiency of the barrier are altered by minute changes in the chemical makeup of the fluids on either side of the membrane. Such disturbances not only permit varying amounts of colloid to pass through the endothelial wall, disturbing the osmotic pressure relations, but, by altering the porosity of the membrane, may enormously increase the amount of fluid lost through it.

Although Krogh [7] attributed permeability of the capillary wall to the endothelial cell, it is today unanimously accepted that the capillary wall rather than the cell is the area through which the passage of fluids occurs. Many substances to which living cells are impermeable readily pass through the capillary wall. This permeability of the wall is not a matter of extreme thinness but a function of the intercellular cementum.

Even before the newer knowledge of ascorbic acid in its relationship to the setting of collagen, Ringer,[8] as well as Herbst [9] and Overton,[10] described the existence of a cohesive material consisting of a reversible calcium salt of a weak acid for binding cells together. In one of my earlier papers on the parallel action of vitamin C and calcium I pointed out the formation of calcium protein ascorbate and the pronounced

5. Zweifach, B. W.: The Structural Basis of Permeability and Other Functions of Blood Capillaries, in Cold Spring Harbor Symposia on Quantitative Biology, Cold Spring Harbor, L. I., New York, The Biological Laboratory, 1940, vol. 8.

6. Chambers, R., and Zweifach, B. W.: Capillary Endothelial Cement in Relation to Permeability, J. Cell. & Comp. Physiol. **15**:255-272 (June 20) 1940.

6a. Ruskin, S. L.: The Vascular Dynamics of the Common Cold, Ann. Otol., Rhin. & Laryng. **55**:904, 1946.

7. Krogh, A.: The Anatomy and Physiology of Capillaries, New Haven, Yale University Press, 1929.

8. Ringer, S.: Concerning Experiments to Test the Influence of Lime, Sodium and Potassium Salts on the Development of Ova and Growth of Tadpoles, J. Physiol. **11**:79-84, 1890.

9. Herbst, C.: Arch. f. Entwcklngsmechn. d. Organ. **9**:424, 1900.

10. Overton, E.: Beiträge zur allgemeinen Muskel- und Nervenphysiologie, Arch. f. d. ges. Physiol. **105**:176-290, 1904.

tendency for vitamin C to form serum protein complexes.[10a] Zweifach [5] pointed out that, as a consequence, the physical state of cellular membranes could be varied by changing the hydrogen ion concentration and the calcium content of the medium. It was therefore not surprising to find that variations in the permeability of the walls of the blood capillaries of the frog could be readily induced by subjecting the vessels to conditions which Ringer,[8] Herbst [9] and Overton [10] found to affect the intercellular cement.

Chambers and Zweifach [6] made direct observations on the capillary circulation of the mesentery of the frog while perfusing the animal with ash-free gelatin mixtures in which the hydrogen ion and calcium contents were varied. They found that alterations of the intercellular cement were brought about by varying the hydrogen ion and calcium contents of the perfusates. The consequent changes in the physical state of the cement substance were detected by the use of carbon particles in the circulating medium. Under normal conditions only occasional specks of carbon adhere to the vessel wall. Conditions favoring a softening or a swelling of the intercellular cement could be detected by an increased sticking of carbon to the capillary wall, with accumulation especially along the endothelial lines. An over-all sticking of the carbon, such as occurred in the presence of excess calcium, was an indication of the production of excess cement. On the other hand, the washing away of the carbon lines indicated the dissolution of the cement.

Several criteria were used to determine the effects of variations of hydrogen ion and calcium concentrations on fluid exchange. Macroscopic evidence was obtained by noting the time of development of edema in the exposed intestinal loop and in the spleen. The microscopic evidence depended on the type of particulate matter suspended in the perfusate. In the case of avian cells, evidence for leakiness was a dispersal of the cells throughout the lumen of the capillaries leading to extravasation of many cells and general stasis. Similarly, with carbon suspensions, a marked leakiness of the wall was shown by a dispersal of all the particles throughout the capillary lumen, in contrast to the normal situation, in which they were mostly confined to a central channel during their circulation through the vessel.

Six solutions were used by Chambers and Zweifach.[6]

Solution 1 was used as a control and maintained the conditions of normal circulation with no edema for over two hours. The solutions were buffered with phosphate mixtures, and the hydrogen ion concentration was determined before and after each experiment. To the

10a. Ruskin, S. L.: Studies on the Parallel Action of Vitamin C and Calcium, Am. J. Digest. Dis. **5**:408, 1938; Studies in Calcium Metabolism: Further Consideration to Comparative Studies of Physico-Chemical Properties of Gluconate and Cevitamate of Calcium and of Vitamin C, ibid. **5**:676, 1938.

calcium-free solutions was added an amount of sodium oxalate calculated to neutralize the ionized calcium normally present in frogs. Isotonic solution of three chlorides (Ringer's solution) was used to remove any calcium that might enter the perfusate from the tissues.

The solutions used contained a suspension either of carbon or of avian red cells. The filtered carbon suspension flowed readily through the capillaries and showed no signs of agglutination. The avian cells maintained their normal plasticity and nonadhesiveness as they coursed through the blood vessels of the frog.

Normal calcium: With perfusates containing the normal amount of calcium, conditions resembled those observed when carbon was injected directly into the normal blood circulation. No marked carbon sticking was observed for about one hundred to one hundred and ten minutes. Lines of carbon then began to appear and were followed somewhat later (twenty-five to thirty minutes) by the appearance of edema. Adhesion of carbon to the endothelial lines developed earlier when the solution was acidified to p_H 6.6 to 6.8. However, throughout the different p_H ranges the time of appearance of carbon sticking to the cement and the time of appearance of edema followed one another by a definite interval of about twenty-five to thirty minutes.

Double calcium: Excess calcium in the perfusion medium increased the adhesiveness of carbon to the capillary wall. This was especially marked with the acidified perfusate, p_H 6.8, so that carbon adhered not only to the endothelial lines but also to the inner surface of the endothelial cells. Excess calcium was therefore accompanied by an excessive deposition of cement material. The deposition of cement on the inner surface of the capillary markedly increased the resistance encountered by the circulating fluid, often to the extent of completely clogging the vessels. Perfusions with suspension of red cells in mixtures of Ringer's solution and gelatin containing double the normal content of calcium at p_H 7.5 maintained an adequate circulation for thirty to forty minutes. The circulation then gradually became abnormal and sluggish. No definite symptoms of edema accompanied this.

How important a high calcium level is for the treatment of the profuse discharge in inflammation of the upper respiratory tract becomes obvious from the experimental data of Chambers and Zweifach.[6] The direct effect of calcium on the intercellular cementum gives clear indications for the calcium ion.

Calcium-free solutions used for perfusion caused the capillary wall to become excessively leaky. A progressive washing away of the cement occurred, especially in the more acid p_H ranges. This was accompanied by the appearance of leaky spots and the sudden deflection of carbon into these from the central stream circulating through the vessel. Discrete aggregates of carbon were seen in contrast to the carbon lines found

with calcium-containing perfusates. Red cells were present, flattened against the wall, and were often extruded through these leaky spots. Stasis and edema appeared extremely early in the acid p_H ranges. The effects obtained in the absence or the presence of calcium were completely reversed by changing the perfusate.

p_H: The hydrogen ion concentrations of the perfusates had marked effects on the cementum. An increase in the acidity of the normal perfusate to p_H 6.6 to 6.8 induced an early and intense sticking of carbon, followed by pronounced leakiness. In the alkaline p_H ranges (7.8 to 8), the cement appeared to be increasingly stabilized, and edema was absent for over two hours; with increased alkalinity and acidity, respectively, of the medium, the permeability of the capillary wall and the stickiness of carbon reached comparatively constant values.

This experimental finding militates strongly against Fabricant's [1] idea of the benefit of acid solutions for the nasal membranes. He arrived at his decision to use an acid solution by determining the hydrogen ion concentrations of nasal secretions in health and in disease but the concentration of hydrogen ion of the secretion is not necessarily an index of the desirability of that concentration—certainly not in view of Zweifach's [5] findings on the influence of hydrogen ion concentration on intercellular cementum. More important still is the necessary emphasis to be placed on the electrolyte in the solution. The physical state of the capillary wall depends on the calcium content of the perfusate. The conditions produced are reversible and appear closely analogous to those of epithelial membranes in which the intercellular cement reacts to inorganic salts as if it were itself a salt. The absence of calcium from the medium serves to increase the instability of the cement substance through the replacement of the relatively stable but reversible calcium salt by the soluble sodium or potassium salt. Increased acidity acted to increase the ionization of the cement and enhanced its dissipation. An important role of the endothelial cell would appear to be the continual secretion of an intercellular cement, the chemical stability of which controls the permeability of the wall of the blood capillary.

While the intercellular cement comprises the actual filter, it nevertheless has deposited on it a layer of protein from the blood. This is probably due to the tendency of vitamin C in the cementum to form serum protein complexes as I have previously described. The adsorption of colloids on the capillary membrane serves to alter the behaviors of the membrane and the exchange of material through it. The deposition of such an external layer will vary with changes in the cement and in the circulating medium.

Colloidal perfusates were far superior to iso-osmotic crystalloid mixtures (Ringer's solution–mannitol mixtures) in maintaining normal circulatory conditions. It is significant that mixtures of Ringer and

mannitol solutions did not exhibit coating properties. The streaming of the perfusate through the capillaries was accompanied by a washing away of the coating of the blood proteins of the host, leaving the vessel wall denuded and in an excessively porous state. When replaced by colloidal perfusates (mixtures of Ringer's solution and gelatin), the inner surface of the denuded capillaries became coated with a thin layer of colloid. This not only rendered the wall relatively less permeable to loss of fluid but also curtailed the outward diffusion of the colloidal components.

The work of Danielli,[11] Hill [11a] and Menkin [12] shows similar results indicating the influence of colloids controlling the pore diameter of the capillary wall in the frog. Danielli attributed to the blood platelets the function of clogging the pores of the capillary membrane.

What is extremely interesting is that in my earlier work in 1938 postulating as one of the functions of vitamin C the formation of the serum protein complex, I did not have the work of Drinker [12a] and Saslow,[13] who found that acacia–Ringer solution perfusates alone were not sufficient to curtail the onset of edema for more than sixty to eighty minutes. The addition of 20 per cent serum markedly reduced the rate of development of edema. Thus changes in the porosity of the capillary wall to the extent of permitting the colloidal constituents of the blood to leak through may be produced by factors impairing the adsorption of the serum proteins to the inner surface of the vessel.

One can now see that the simple factor of hydrogen ion concentration cannot stand alone as an indication of usefuless in nasal therapy. The electrolyte may play the deciding factor in the usefulness or the harm of any solution.

Clinically, the theoretic aspects were remarkably borne out. Turnbull [14] in 1941 introduced intranasal therapy with the sodium salt of sulfathiazole. Following the initial burst of enthusiasm for sulfonamide medication and the intranasal use of sodium sulfathiazole came a series of reports, particularly from Fletcher,[15] showing disastrous effects

11. Danielli, J. F.: Capillary Permeability and Oedema in Perfused Frog, J. Physiol. **98**:109-129 (March 14) 1940.

11a. Hill, L.: J. Physiol. **54**:93, 1921.

12. Menkin, V.: Dynamics of Inflammation: An Inquiry into the Mechanism of Infection Processes, New York, The Macmillan Company, 1940.

12a. Drinker, C. K.: Permeability and Diameter of Capillaries in the Web of the Brown Frog (R. Temporaria) When Perfused with Solutions Containing Pituitary Extract and Horse Serum, J. Physiol. **63**:249-269 (Aug. 27) 1927.

13. Saslow, G.: Relation Between Oxygenation of Fluids and the Occurrence of Edema in Perfused Frog Web, Am. J. Physiol. **124**:360-368 (Nov.) 1938.

14. Turnbull, F. M.: Intranasal Therapy with Sodium Salt of Sulfathiazole in Chronic Sinusitis, J. A. M. A. **116**:1899-1900 (April 26) 1941.

15. Fletcher, R.: Sodium Sulfathiazole: Its Caustic Action, California & West. Med. **55**:94 (Aug.) 1941.

on the nasal mucosa. Although the hydrogen ion concentration of the sodium sulfathiazole was in the neighborhood of p_H 10, still the corrosive effects were greater than those observed with other intranasal medications with solutions of like hydrogen ion concentration, such as silver nucleinate solution with a p_H of 9.5 to 10. The difference could therefore be attributed to the local effect of the ionized sodium in the sodium sulfathiazole. This should not be confused with the effect of ingested sodium, which has a diuretic effect tending to diminish loss of fluid through the nasal membranes. To prove this local action of the sodium ion as compared with the calcium, the calcium sulfathiazole was prepared and used clinically in a 3 per cent solution. In a series of several hundred patients, with the calcium sulfathiazole being used in the form of nasal drops at home and employed locally as nasal packing and spray, as well as for irrigation of the antrums, not a single local irritation was encountered with the exception of that in a patient who was sensitive to sulfathiazole and who presented a marked generalized rash and edema of the lids. This same patient had had previous manifestations of sulfathiazole sensitivity which had been overlooked. There were no others with systemic disturbances from the calcium sulfathiazole medication. The impression gained from its clinical use was that the calcium salt was a far less toxic agent than the sodium salt and that its intranasal use was not attended by any toxic manifestation. The calcium salt also had an almost ideal p_H range between 8 and 8.5. It is not too frequently that one can carry over experimental findings into such striking clinical application.

CONCLUSION

1. p_H determinations of intranasal solutions must be considered only in conjunction with electrolyte contents and other factors affecting permeability of membranes.

2. Calcium and ascorbic acid are the controlling factors in the formation of intercellular cementum.

3. An alkaline p_H range, 7.8 to 8, is more conducive to maintenance of the normal intercellular cement substance and the normal permeability of membranes and hence represents the desirable hydrogen ion concentration for intranasal medication.

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PRESSURE TREATMENT OF ALLERGIC SINUSITIS

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THE APPLICATION of pressure has been used to facilitate the healing of wounds, burns, fractures and chronic ulceration of the leg and to prevent hemorrhage, cavitation, edema and stagnation of tissue fluid following surgical intervention and skin grafting. Pressure was first used in the maxillary sinus by Ferris Smith [1] to hold a cutaneous graft in place. Pressure has also been used in the maxillary sinus by Shea [2] to hold the walls in position after reduction of a fracture. In most of the aforementioned procedures the use of pressure was designed primarily to prevent accumulation of, or to promote removal of, an abnormal amount of tissue fluid.

Allergic disease of the nose and paranasal sinuses is characterized by edema due to accumulation of an abnormal amount of tissue fluid in the interstitial tissue spaces of the sinal mucosa.[3] If the allergenic stimulus is brief, the excess tissue fluid is absorbed and the mucoa returns to normal. If the stimulus is prolonged, an excessive amount of fluid may remain in the mucosa of the sinuses, become stagnant and participate in a series of pathologic changes in the mucosa recognized clinically as subacute or chronic allergic sinusitis. Since stagnation of tissue fluid is a constant pathologic finding in allergic disease of the sinuses, the variables which affect formation and removal of tissue fluid and the application of these variables to the physiology of the mucosa of the sinuses will be considered briefly. These variables are arterial capillary filtration, venous capillary absorption, tissue pressure and lymph flow.

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1. Smith, F.: Plastic Surgery: Its Interest to Otolaryngologist, J. A. M. A. **75**:1554-1559 (Dec. 4) 1920.

2. Shea, J. J.: Management of Fracture Involving Paranasal Sinuses, J. A. M. A. **120**:745-749 (Nov. 7) 1942.

3. Robison, J. M.: Physiology and Functional Pathology of the Lymphatic System Applied to Allergy of the Nose and Paranasal Sinuses, J. Allergy **17**: 53-69 (March) 1946.

Tissue fluid consists of capillary filtrate, interstitial fluid, intracellular fluid and lymph. These may be considered to be the same except for the amount of protein contained.[4] Arterial capillary filtration increases with irritation (allergic, thermal, chemical), inflammation and lowered colloid osmotic pressure of the blood (hypoproteinemia). The arterial capillary filters protein, salts and water. Arterial capillary pressure is lowered and filtration is reduced by dilatation of the arteriovenous anastomoses. The venous capillary absorbs water, salts, certain diffusible products and no protein. Absorption is retarded by increased colloidal osmotic pressure of the tissue fluid and by increased venous pressure (passive congestion). Absorption is accelerated by lowered venous pressure (elevation of the part) and increased tissue pressure (inherent tissue elasticity and physical pressure). Tissue pressure is gaged by the resistance tissue offers to dilation of its interstitial spaces by edema fluid. According to its magnitude, it offers resistance to capillary filtration, promotes absorption, aids lymph flow and affects the process of osmotic pressure and molecular diffusion. The fascial planes of the body and the integument covering the part resist an increase in tissue pressure. Tissue pressure decreases as the interstitial spaces lose their elasticity in the course of long-continued dilation by edema fluid; it increases as the interstitial spaces become filled with newly formed fibroblasts.

The relation of tissue pressure to lymph flow and pericellular physiology is manifest in the phylogenetic development of the lymphatic system. Every living cell requires food and an excretory mechanism proportioned to the cell's activity. The lymphatic system develops in the phylogenetic scale of life as it becomes necessary to remove from the pericellular environment substances not readily absorbed by the blood. It develops as a constantly changing pericellular environment and becomes essentially an excretory mechanism for the products of cell metabolism and food (protein) unused by the body cells.[4] The lymph bed consists of the intercellular and interstitial spaces and lymph channels in the tissues, and drains into the primary echelon of nodes. In mammals the lymph flows normally by active and passive motion, muscle contraction, massage and gravity. During pathologic states, because of immobility of the part, lymph flow occurs by gravity, tissue pressure and pulsations transmitted from the dilated arteriovenous anastomoses to the lymph channels by hydrostatic pressure. Particulate matter which gains entrance to the tissues of the body, protein unused as food by the body cells, products of cell metabolism, bacterial products, cellular detritus and small amounts

4. Drinker, C. K., and Yoffey, J. M.: Lymph and Lymphoid Tissue, Cambridge, Mass., Harvard University Press, 1941, pp. 4, 26, 55, 58, 80, 83, 189-190, 284, 286, 290, 300, 301, 305 and 307-309.

of water are carried from the cell bed by the lymphatic system. Disorders of this system are characterized by lymphatic blockage and retention of these substances in the tissues with resulting increase in tissue fluid due to the water-holding power of the retained protein. Acute lymphatic blockage occurs following deposit of cells, fibrin, etc., in the interstitial tissue spaces, lymph channels and nodes (infection and cancer). Chronic lymphatic blockage follows fibrosis of the interstitial tissue spaces due to prolonged presence of stagnant tissue fluid and bacterial products and parasites or long-continued absorption of particulate matter (interstitial fibrosis, elephantiasis, pneumonoconiosis). Stagnation of tissue fluid renders a part susceptible to recurrent infection. This has been proved by the frequent occurrence of streptococcic infection in the leg of the dog subjected to experimental elephantiasis.[5] This marked susceptibility of a part containing stagnant tissue fluid to recurrent infection forms the basis for the frequent infection or "catching cold" experienced by patients suffering from subacute or chronic allergic sinusitis.

The function of the normal sinal mucosa consists principally in the movements by which the cilia and their mucus covering keep the cavity of the sinus free of extraneous material. The normal mucosa is less than 1 mm. thick and is composed of a single or a stratified layer of ciliated columnar cells placed on a stroma of loosely spaced fibroblasts with interstitial spaces which are capable of being rapidly and widely distended by edema fluid. Normally the interstitial spaces are "dry"; i. e., they contain only enough extravascular fluid to nourish the cells. These spaces are mobile in that they offer little tissue pressure resistance to increased capillary filtration during infection or irritation. Since all air-containing cavities of the body tend to lose their air when they become severely infected, the edematous increase in volume of the mucosa and the secretion in the sinus should, when necessary, be able to fill entirely the cavity of the sinus.[6] Filling of the sinus cavity with edematous membrane and secretion drives air from the cavity, raises the tissue pressure and allows lymph to be pumped from the part by pulsations transmitted to the lymph vessels from the dilated arteriovenous anastomoses by hydrostatic pressure. This explains the tendency of large sinuses to become chronically infected. Their size may be so great that the swelling of the mucosa and the secretion cannot approxi-

5. Drinker, C. K.; Field, M. E.; Ward, H. K., and Lyons, C.: Increased Susceptibility to Local Infection Following Blockage of Lymph Drainage, Am. J. Physiol. **112**:74-81 (May) 1935. Drinker, C. K.; Field, M. E., and Homans, J.: The Experimental Production of Edema and Elephantiasis as a Result of Lymphatic Obstruction, ibid. **108**:509-520 (June) 1934.

6. Robison, J. M.: Lymphangitis of the Retropharyngeal Lymphatic System, Arch. Otolaryng. **40**:385-395 (Nov.) 1944.

mate the volume of the sinus. This leads to air cavitation and stagnation of tissue fluid in the mucosa.

Fibroblasts when given a normal amount of food (protein) will not proliferate. When surrounded by tissue fluid of high protein content for an extended period they proliferate and fill the dilated tissue spaces. This proliferation results in permanent fibrous overgrowth and thickening of the part with loss of tissue elasticity.[4] When the fibrosis becomes extensive, the mucosa cannot become edematous and approximate the capacity of the sinus and thereby raise its tissue pressure. As fibrosis involves the region of the ostium, nutrition of the glands is reduced, and the mucous secretion is diminished or absent. This process terminates in retention of secretion in the sinus and lymph stasis. The latter condition is due to inability of the blood vessels to transmit their pulsations to the lymph bed by hydrostatic pressure. The foregoing principles of physiology and functional pathology will be applied to the various stages of allergic maxillary sinusitis.

ALLERGIC MAXILLARY SINUSITIS

This type of sinusitis may be divided into three stages: acute, subacute and chronic.

1. Acute allergic sinusitis usually accompanies or follows hay fever. The patients usually present themselves during the latter part of, or weeks after, the hay fever season, complaining of constant nasal stenosis, bronchial asthma and possibly other symptoms of sinusitis. This nasal stenosis often has been seriously aggravated by excessive intranasal medication. The constant stenosis indicates that there is present in the lymph bed of the sinuses an excessive amount of tissue fluid which the lymph pump mechanism is trying vainly to remove. The secretion in acute allergic sinusitis is usually white, mucoid and of small amount. The total protein content is low, the globulin content is relatively high and the colloidal osmotic pressure is low. Apparently, this type of secretion should be readily removed from the sinus by natural processes; instead it often remains in the sinus for a protracted time, and this leads to progressive pathologic changes in the mucosa. Irrigation of the maxillary sinus usually relieves the patients of their nasal and asthmatic symptoms. If the mucosa has become very edematous, irrigation of the sinus through a puncture of the inferior meatus gives better results than irrigation through the natural ostium. Puncture of the maxillary sinus and fistulization of the mucosa allow trapped tissue fluid to be drained and definitely hasten recovery. In the treatment of acute allergic sinusitis it is extremely important to differentiate between improvement and cure of the sinusitis. Often the physician is content to be guided entirely by the patient's symptoms, which may disappear

completely after the season of hay fever has passed. However, the mucosa of the maxillary sinuses often remains edematous and is susceptible to recurrent infection which may be manifested by the patient's frequently "taking cold" or having symptoms of allergic rhinitis.

2. Subacute allergic sinusitis follows the acute stage when excess tissue fluid remains in the sinal mucosa. Differentiation between this and the chronic stage often is possible only by histologic examination of the amount of fibrosis and of polypoid degeneration which has occurred in the mucosa. The patients frequently state that they have had "sinus trouble" for years and form a large percentage of those who think that "once you have sinus trouble you will always have sinus trouble." The mucosa of the sinuses of these patients presents little that is pathologic—a slight increase in white blood cells and the retention of an excessive

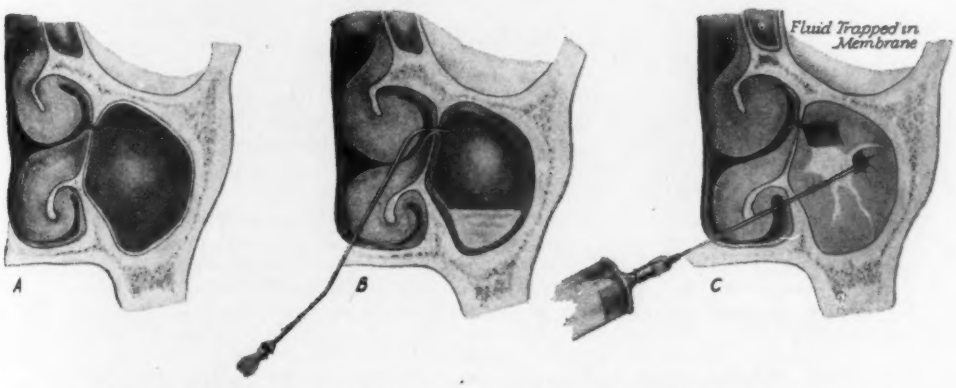

Fig. 1.—Drawings showing the transition of acute allergic rhinitis into acute allergic sinusitis.

A. During seasonal hay fever patients suffer from alternating nasal stenosis due to increased turgescence of their intranasal tissues. Their nasal stenosis varies directly with the concentration of allergen in the air and subsides promptly as the allergen disappears.

B. Patients with acute allergic rhinitis and sinusitis usually consult the rhinologist during or soon after the hay fever season, complaining of complete nasal stenosis or asthma or both. Excessive turgescence of intranasal tissue is a constant finding in these patients and often has been intensified by excessive intranasal medication. Irrigation of the maxillary sinus through the natural ostium may relieve these patients of their nasal stenosis and asthma if the sinusitis is mild.

C. If the sinusitis is severe and tissue fluid has become trapped in the sinal mucosa, irrigation of the sinus and fistulization of the mucosa by sinal puncture definitely accelerate recovery. The secretion recovered from the sinuses is usually white, mucoid and of low protein content with low colloidal osmotic pressure. Clinical experience leaves no doubt that absorption of components of the secretion or of trapped tissue fluid is an etiologic factor in the constant nasal stenosis and asthma. Bacteria may or may not be demonstrable.

amount of tissue fluid in its interstitial spaces. The interstitial lymph pathways are not blocked in this mucosa; so the turbinal tissue remains swollen as part of the effort of the lymph pump mechanism to remove

components of extravascular fluid from the lymph bed.[4] Early during this stage the mucosa may be so edematous that it approximates the capacity of the sinus. Later, as fibrosis occurs, the mucosa may contract and remain in this redundant form for years, being particularly susceptible to recurrent infection. Local pressure is applied best to this mucosa before the newly formed fibroblasts appear.

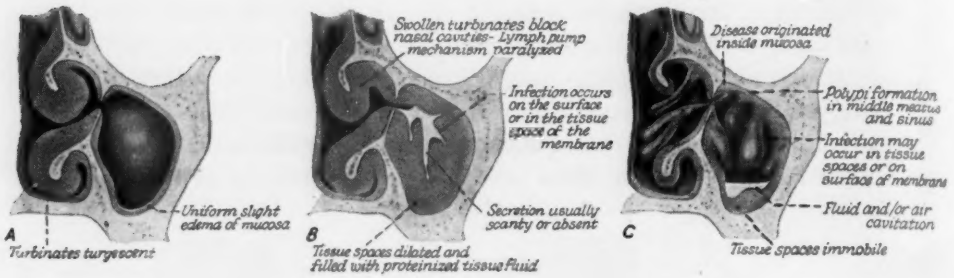
Uniform slight edema of mucosa
A
Turbinates turgescent
Swollen turbinates block nasal cavities- Lymph pump mechanism paralyzed
Infection occurs on the surface or in the tissue space of the membrane
Secretion usually scanty or absent
B
Tissue spaces dilated and filled with proteinized tissue fluid
Disease originated inside mucosa
Polypi formation in middle meatus and sinus
Infection may occur in tissue spaces or on surface of membrane
Fluid and/or air cavitation
C
Tissue spaces immobile

Fig. 2.—Drawings showing the stages of transition of subacute allergic rhinitis and maxillary sinusitis into chronic allergic maxillary sinusitis. The absence or the presence of irreversible structural changes in the sinal mucosa is the criterion used in this classification without respect to the length of time the pathologic change has been present.

A. Subacute allergic rhinitis is characterized by intermittent or constant turgescence of the turbinates and mild uniform edema of the sinal mucosa. The mucosa may contain several times its normal amount of extravascular fluid and yet be less than 1 mm. thick. This edema may not be readily discernible when studied roentgenographically with or without contrast mediums, but it is visible by direct antroscopy. The patients rarely have excess secretion in their sinuses unless they are passing through an episode of infection. This stage of the disease formerly has been classified as chronic allergic rhinitis because of its tendency to persist for a protracted period before easily demonstrable changes occur in the mucosa of the maxillary sinuses. Here it is classed as subacute, because irreversible structural changes have not occurred in the sinal mucosa. Patients in this stage may be relieved of their nasal stenosis and their increased susceptibility to sinus infection by the application of local pressure to the mildly edematous mucosa of the maxillary sinuses.

B. Subacute allergic sinusitis is characterized by constant turgescence of the turbinates and marked edematous thickening of the sinal mucosa which at first may approximate the capacity of the sinus. Later, newly formed fibroblasts appear in the stroma of the mucosa, contract and reduce the volume of the mucosa. The mucosa may remain in this redundant form for years and the abnormality may manifest itself clinically in the patient's increased susceptibility to recurrent sinus infection.

C. Chronic allergic sinusitis follows the subacute stage when the alternating areas of dilated tissue spaces and fibrosis become extensive. Following repeated episodes of infection, as the tissue pressure rises, polypoid formations protrude from the areas of dilated tissue spaces in the mucosa of the sinuses and middle meatuses. The efficiency of the application of local pressure to the sinal mucosa in returning the mucosa to normal or near normal during subacute and chronic allergic sinusitis is directly proportional to the extent of irreversible structural changes in the mucosa. The patient's symptoms may be entirely relieved by the application of local pressure without the sinal mucosa being converted to normal. Apparently, as certain components of the stagnant tissue fluid in the sinal mucosa are absorbed there occurs simultaneously a definite reduction in the patient's susceptibility to recurrent sinus infection.

3. Chronic allergic sinusitis follows the subacute stage when the increase of protein and of bacterial products in the tissue fluid promotes the growth of fibroblasts. The fibrosis of the mucosa in strictly purulent sinusitis is uniform. The fibrosis in chronic allergic disease is characterized by formation in the mucosa of alternating areas of fibrosis and

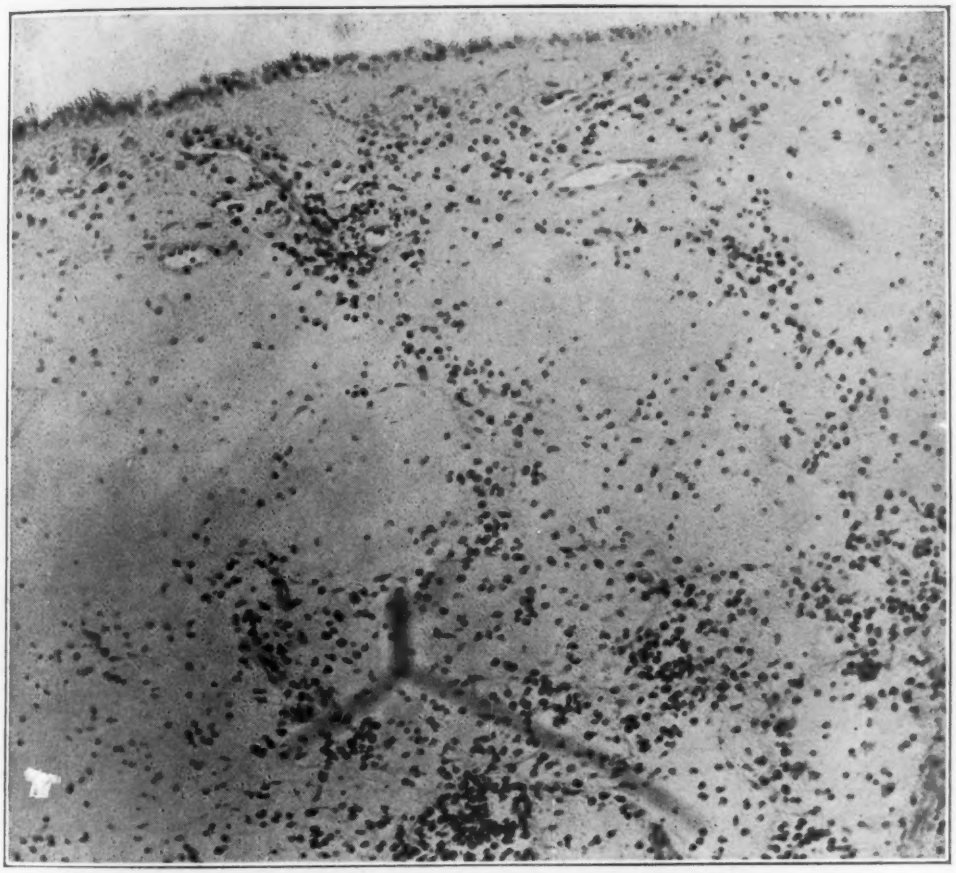

Fig. 3—Photomicrograph of an area of dilated tissue spaces in the mucosa of the maxillary sinus of a patient with subacute allergic sinusitis; × 158. The pathologic changes presented by this mucosa are a slightly increased number of white blood cells, dilated tissue spaces containing excessive tissue fluid and areas of newly formed fibroblasts. Local pressure is more effective if applied to this type of mucosa before the areas of newly formed fibrous tissue become extensive. The stagnation of tissue fluid in this mucosa may continue for years; it renders the patient susceptible to recurrent sinus infection and often is associated with recurrent attacks of bronchial asthma. Nasal stenosis and asthma may entirely disappear after pressure has been applied locally to this type of mucosa. If acute asthmatic or infectious symptoms or both are present, systemic complications, such as pleurisy and pneumonitis, are prone to occur after trauma of this edematous mucosa.

dilated tissue spaces.[7] This process may extend to the stroma of the mucosa of the middle meatus, which is composed normally of loosely spaced fibroblasts through which drains the lymph from the anterior

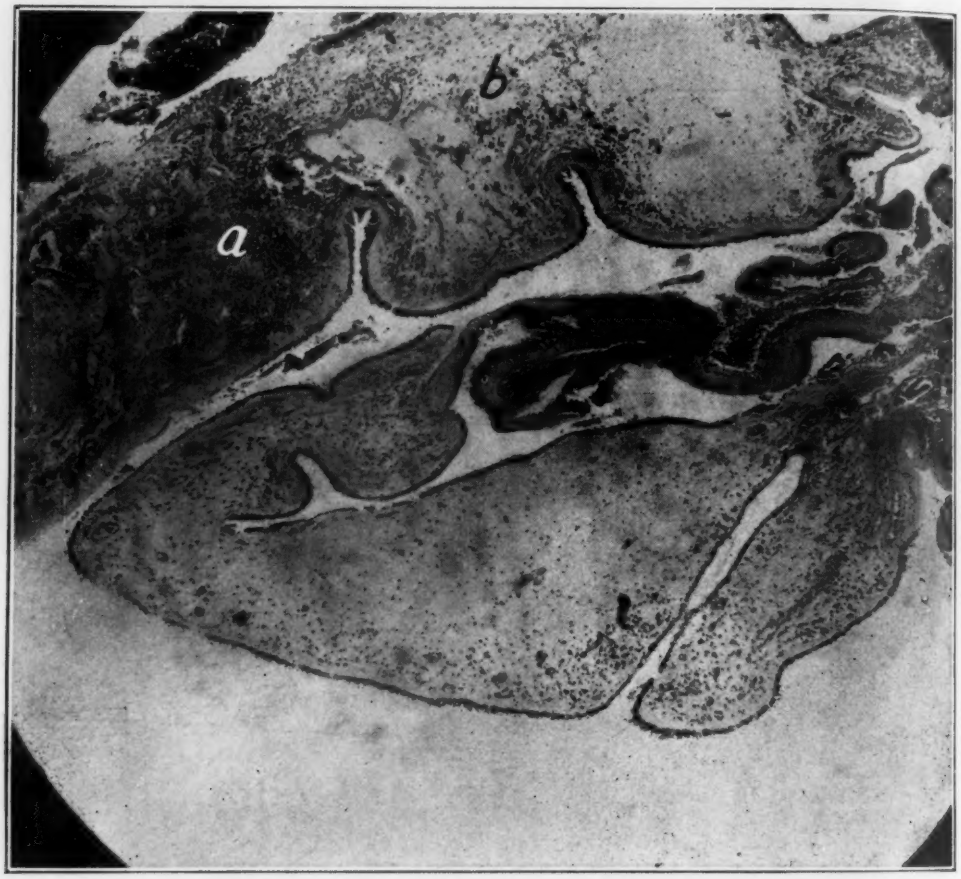

Fig. 4.—Photomicrograph of the mucosa of a patient with chronic allergic sinusitis. This mucosa is characterized by the formation of alternating areas of fibrosis (*a*) and dilated tissue spaces (*b*). This specimen shows the early stage of formation of polypi. As a consequence of repeated episodes of infection, with the tissue pressure rising, polypi protrude from the areas of dilated tissue spaces (*b*). In the same manner newly formed polypi may be produced in the middle meatus by the hydrostatic pressure exerted by application of local pressure to the edematous mucosa of the maxillary sinus. This mechanism of formation of polypi is comparable to that of the polypi formed in the middle meatus as the tissue pressure rises during acute maxillary sinusitis. Polypi formed during acute inflammation may disappear as the inflammation subsides, owing to the inherent contractility and unimpaired elasticity of the stroma of the sinal mucosa. Polypi formed from mucosa which has been edematous for a protracted period remain and become fibrotic because of the reduction of tissue pressure which follows loss of elasticity of the stroma of the sinal mucosa.

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7. Robison, J. M.: Lymphangitis of the Mucosa of the Paranasal Sinuses, Texas State J. Med. **40**:193-199 (July) 1944.

group of sinuses. Following prolonged infection, as abnormal amounts of the products of cell metabolism, protein and bacterial products drain from the anterior group of sinuses through the lymph channels of the middle meatus, lymphatic blockage occurs, due to cellular infiltration and fibrosis. Following repeated infections, as the tissue pressure rises, polypoid formations of the mucosa protrude from the areas of dilated

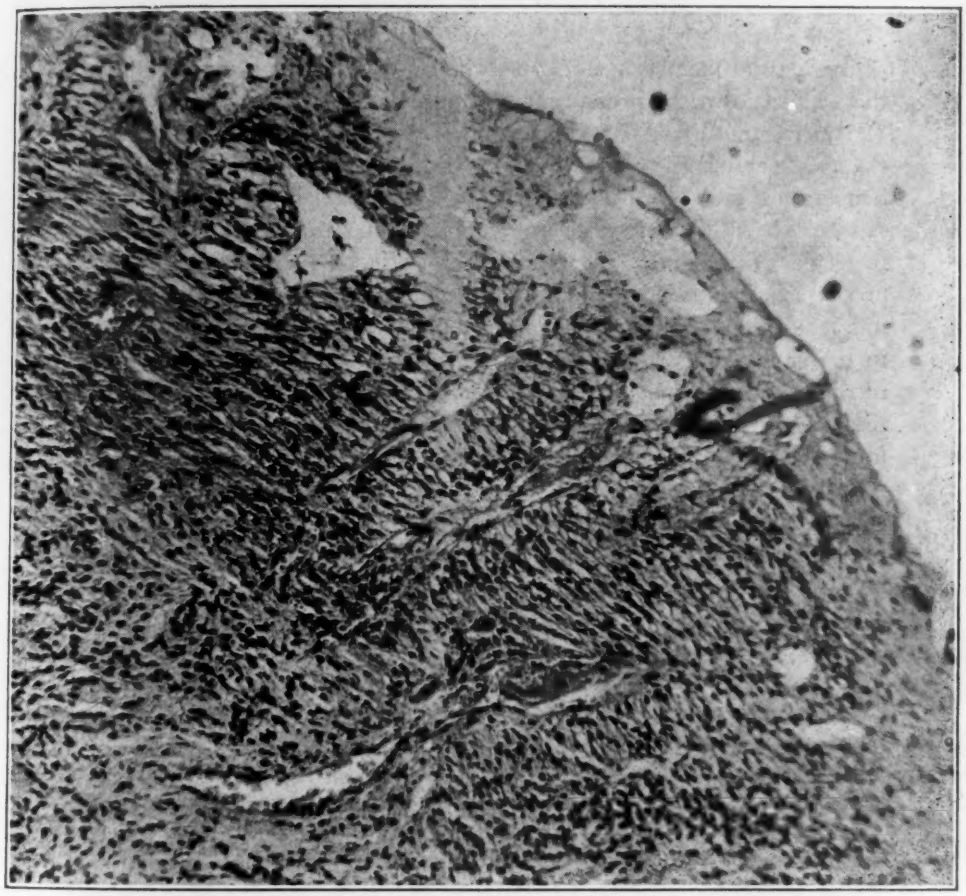

Fig. 5.—Photomicrograph of the sinal mucosa of a patient with advanced chronic purulent maxillary sinusitis; × 200. This mucosa shows advanced uniform fibrosis of its stroma with destruction of its ciliated epithelium and atrophy of its glands. These are irreversible structural changes; the mucosa cannot be returned to normal by application of local pressure.

tissue spaces in the mucosa of the sinus and the middle meatus. These polypi may approximate or entirely fill the capacity of the sinus and are nature's effort to raise the intrasinal pressure by driving air from the cavity with an incompressible fluid medium through which hydrostatic pressure may be utilized to transmit arterial pulsations to the lymph

channels. When polypoid degeneration of the mucosa of the maxillary sinus and the middle meatus has become extensive, many rhinologists consider it necessary to remove the mucosa so that a new membrane containing a new lymphatic system may be formed. Frequently, however, this operation affords relief only temporarily, and the polypi return and persist.

PRESSURE RATIONALE

The physiology of the body is closely governed by the permeability of the natural membranes. The variables of membrane permeability as they affect osmotic pressure and molecular diffusion are (1) time, (2) membrane area, (3) concentration difference of the colloid or the electrolyte across the membrane, (4) size of the diffusing molecules, (5) temperature and (6) pressure.[8] Of these variables, time and pressure can best be utilized to accelerate removal of tissue fluid and promote molecular diffusion. The functional pathology of increased tissue pressure is illustrated in figure 6. Application of local pressure to the mucosa of the maxillary sinus is accomplished when the air and secretion in the cavity of the sinus are replaced by a balloon filled with a fluid medium through which arterial pulsations may be transmitted to the tissue spaces and lymph channels by hydrostatic pressure. If the formation of polypi is nature's attempt to relieve stagnation of tissue fluid by filling the sinus cavity with an incompressible fluid medium, it seems logical to place an artificial polypus in the maxillary sinus during the early stages of the stagnation of tissue fluid before fibrosis and permanent thickening of the mucosa occur.

An artificial polypus has been utilized for this purpose as follows: A relatively small nasoantral opening is made under the inferior turbinate. If this opening is made too large, the balloon may tend to herniate through it. In this opening a no. 16 French self-retaining catheter may be placed to aid in keeping the opening patent. One or two weeks later, after the postoperative reaction has subsided, a no. 12 French self-retaining catheter which has had its self-retaining head enclosed in a small distensible natural rubber balloon as portrayed in figure 7 is inserted into the sinus. The catheter is cut off so that its nasal end rides comfortably and unseen in the posterior part of the vestibule of the nose. The balloon is then, but preferably a few days later, distended with iodized oil. Iodized oil is used because its specific gravity (1.35), being higher than that of blood plasma (1.027), allows it to displace the sinus secretion and because the progress of distention may be observed in roentgenograms. Oil is added to the balloon at weekly intervals at first, but later it may be sufficient to add oil at two or three week intervals. The patient's sensation of pressure is the sole guide as to how much oil to add. Oil should be added until the patient experiences a sensation of fulness which is neither uncomfortable nor painful. The nasal end of the catheter is tied with a no. 7 braided silk cord, care being taken to tie the knot on

8. Davson, H., and Danielli, J. F.: The Permeability of Natural Membranes. New York, The Macmillan Company, 1943.

the side of the catheter away from the nasal septum. Most of the difficulty patients experience while wearing this balloon arises from irritation of the septum and tip of the nasal vestibule by the nasal end of the catheter. This irritation may be minimized by cutting the catheter so that its intranasal end will rest at the mucocutaneous junction. The application of too much pressure should be avoided. The object in using this artificial polypus is not to drive the edema fluid from the mucosa by force but to provide a fluid incompressible medium through which pulsations may be transmitted from the arteries to the tissue spaces and lymph channels and thus facilitate molecular diffusion and lymph flow, which transform stagnant into changing tissue fluid which can be absorbed.

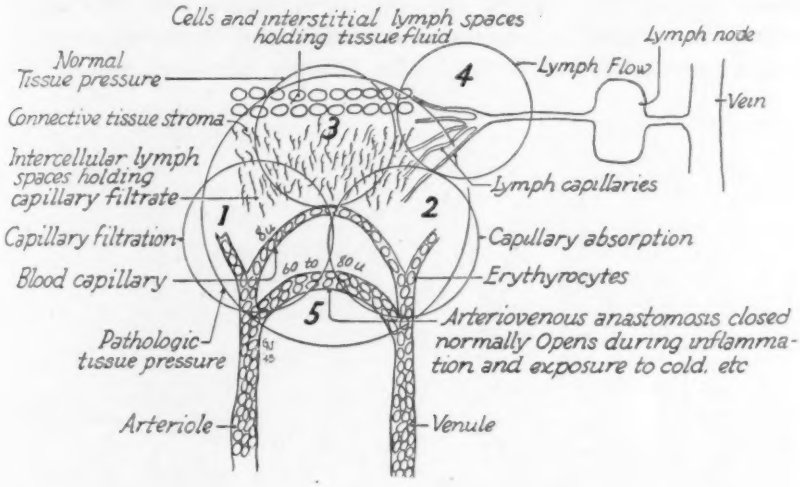

Fig. 6.—Diagram of the relation of capillary filtration, absorption and lymph flow to normal and pathologic tissue pressure. The diagram shows four small circles and one large circle, the latter encompassing a part of each of the four small circles and the open arteriovenous anastomosis. Small circle *1* represents arterial capillary filtration, which is controlled by the colloidal osmotic pressure of the plasma, the permeability of the capillary membrane, the arterial blood pressure and the tissue pressure. The capillary filters water, salts and protein. Small circle *2* represents venous capillary absorption, which is controlled by the colloidal osmotic pressure of the plasma, the permeability of the capillary membrane, the venous blood pressure and the tissue pressure. The venous capillary absorbs water, salts and certain diffusible toxic products but no protein. Small circle *3* represents the normal tissue pressure, which is gaged by the resistance which the tissue offers to dilation of its interstitial spaces by edema fluid. The tissue pressure is proportional to the density and elasticity of the tissue. According to its magnitude, it offers resistance to arterial capillary filtration and promotes venous capillary absorption and lymph flow. Small circle *4* represents lymph flow, which is accelerated by active and passive motion of the part, massage, gravity, pulsations transmitted from the blood vessels to the lymph pathways and increased tissue pressure. Large circle *5* represents increased or functionally pathologic tissue pressure. It overlaps each of the smaller circles and includes the dilated arteriovenous anastomosis. Increased tissue pressure reduces arterial capillary filtration, promotes venous capillary absorption and accelerates lymph flow by transmitting pulsations from the dilated arteriovenous anastomosis to the lymph vessels. Increase in tissue pressure is resisted by the fascial planes of the body and the integument covering the part. As a result of prolonged edema, tissue loses its elasticity and there is then lowering of tissue pressure. Tissue pressure may be raised by application of pressure to the surface of the part.

PRACTICAL CONSIDERATIONS

From the standpoints of pathology and symptomatology allergic disease of the sinuses is a progressive change which often begins early in life and becomes manifest in its more severe forms only after progressive degeneration has occurred in the sinal mucosa. The primary pathologic phase of this disease during its subacute and chronic stages is the retention in the sinal mucosa of an abnormal amount of tissue fluid. Apparently this retention occurs first because of lymphatic blockage or because of the presence in the edema fluid of molecules which cannot be absorbed readily. As the tissue spaces lose their normal contractility, owing to prolonged dilatation, the stagnation of tissue fluid manifests itself clinically by the patients' increased susceptibility

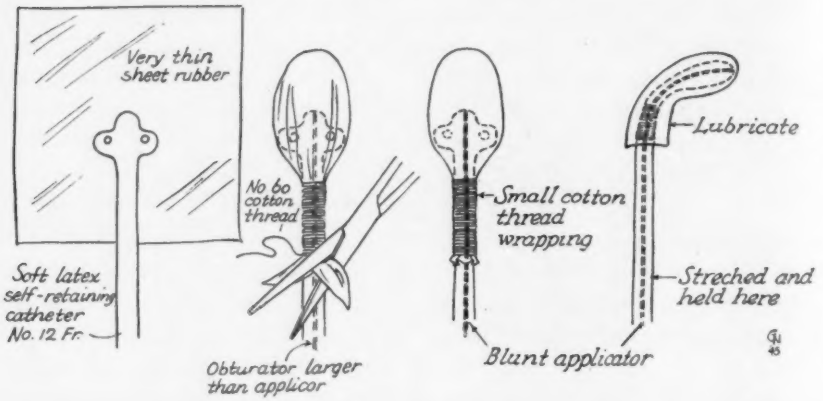

Fig. 7.—Drawing showing construction of a pressure balloon to be used as an artificial polypus in the maxillary sinus. Materials necessary are: a piece of thin rubber 3½ inches (about 9 cm.) square, a no. 12 French soft latex self-retaining catheter, no. 60 white cotton thread, a curved blunt smooth throat applicator, a jelly lubricant and a straight obturator. (The latter may be the shaft of a laryngeal mirror with detachable handle.) The obturator is lubricated and passed through the catheter into its retaining head. The sheet rubber is draped about the head of the catheter so that a balloon will be left around it, about ¾ to 1½ inches (about 2 to 4 cm.) in diameter. The sheet rubber is then wrapped around the neck of the catheter for about ½ inch with three layers of cotton thread, care being taken not to wrap too tightly against the obturator. Knots should be tied at several places along the wrapping. The excess rubber sheeting is cut away, and the balloon is tested with air and pulled tightly against the head of the catheter. The curved applicator is lubricated and inserted. The catheter is stretched, and the balloon is lubricated. It is then ready to be inserted through the nasoantral opening into the maxillary sinus. This appliance may be sterilized by boiling. The cotton thread has shown no tendency to lose its efficiency after being in the sinus for three months.

To remove: The balloon is deflated of oil by cutting the string around the intranasal end of the catheter. The oil is aspirated from the balloon by means of a small curved cannula passed through the catheter. Traction is made on the catheter until the wrapped portion appears under the inferior turbinate. This part of the balloon is then grasped with a small hemostat and the balloon removed by traction. This appliance should be available commercially in the near future. When this appliance is produced by various manufacturers, the rubber in it should be observed for its resistance to oil.

to sinus infection. These patients present themselves complaining of frequent "colds" and constant or intermittent nasal stenosis, and many of them have cough and bronchial asthma. The history of having had nasal stenosis or "sinus trouble" since childhood is almost pathognomonic of allergic sinusitis. Some patients give a history of symptoms beginning years before when they were exposed to dust or a particular pollen, while others relate the occurrence of repeated attacks of hay fever or nasal irritation. Turgescence of the turbinates, discoloration of the nasal mucosa, polyposis, eosinophilia and nasal intonation of the voice are variable findings which are of diagnostic value in relation to the stage of the disease and the activity of concomitant infection.

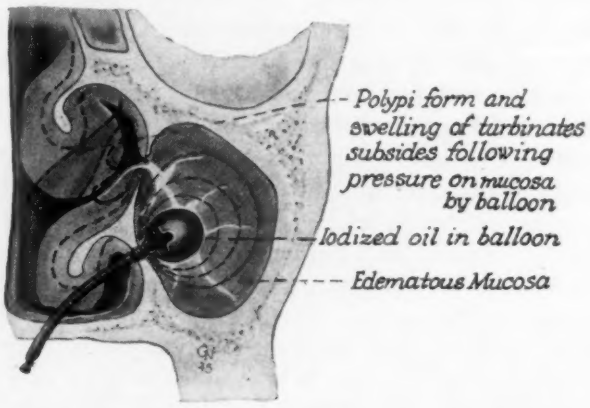
Polypi form and swelling of turbinates subsides following pressure on mucosa by balloon
Iodized oil in balloon
Edematous Mucosa

Fig. 8.—Drawing showing the pressure balloon used as an artificial polypus in the maxillary sinus. This appliance is designed to increase the tissue pressure of the sinal mucosa, thereby accelerating molecular diffusion in, and promoting absorption of, stagnant tissue fluid. Stagnation of tissue fluid in the mucosa of the maxillary sinus is manifested intranasally by increased turgescence of turbinal tissue. After the intrasinal pressure has been raised for a varying period, the turgescence of the turbinates subsides and newly formed polypi may appear in the middle meatus, as shown by the dotted lines. Although this means of bringing local pressure to bear on the mucosa of the maxillary sinus was devised primarily to accelerate removal of stagnant tissue fluid, its use has revealed that certain patients having stagnant tissue fluid and bronchial asthma are relieved of their asthma after application of this pressure. The use of this balloon should not be construed as a "cure" for all types of asthma and sinus infection. Many patients suffering from these afflictions have irreversible structural changes in their sinuses and lungs; these structures cannot be returned to normal by pressure applied to the mucosa of the sinuses. However, the observation that certain patients are relieved of their asthma and bronchitis and regain some of the physiologic functions of the sinal mucosa, with increase of their sense of well-being, after the application of pressure is in accord with the experience of otolaryngologists, who have observed for many years that certain patients suffering from coexisting asthma and sinus disease are relieved of their asthma by operations which remove pathologic mucous membrane from the sinuses. The relief of symptoms following the application of pressure to the mucosa of the maxillary sinuses is additional evidence that the sinuses may be the source of some noxious substance which is an etiologic factor in asthma.

Roentgenograms of the maxillary sinuses made after instillation of iodized oil are of prime diagnostic value in revealing marked edematous mucosa but may be misleading in that they may fail to reveal slight edema. The stroma of the normal mucosa often may be only 0.02 mm. thick.[9] This mucosa may be uniformly edematous and several times its normal thickness without this uniform edema being discernible in roentgenograms in the presence of contrast mediums. This means that several times the normal amount of extravascular fluid may be present in the stroma of the mucosa without being demonstrable except by direct visualization, though its presence may be suspected on interpretation of clinical symptoms, such as the turbinal congestion, which is a manifestation of the attempt of the lymph pump mechanism to remove components of extravascular fluid from the lymph bed of the sinal mucosa.[10]

Intermittent attacks of infection are characteristic of the clinical course of the stagnation of tissue fluid in the sinal mucosa. At first these attacks may resemble mild purulent or allergic rhinitis; however, after a period which may encompass many years the attacks often occur more frequently and may then become continuous, with cough, rales and bronchial asthma becoming part of the clinical picture. If the bronchopulmonary reaction dominates the clinical picture, particularly if these symptoms are associated with purulent disease of the sinuses, treatment of these conditions should precede the application of pressure to the mucosa of the maxillary sinus. The patients should always be placed in care of an allergist and their general practitioner or an internist before any operative procedure on the sinuses is advised. These consultants should control the allergic and bronchopulmonary symptoms and bring the patient to optimum condition before intranasal antrotomy is performed. Usually during this time the rhinologist may accelerate the patient's recovery by irrigating the maxillary sinus through the natural ostium or by irrigating and fistulizing the mucosa through an antral puncture, but certain patients, particularly those with acute asthma, purulent sinusitis, bronchopulmonary symptoms and leukocytosis, may have their symptoms severely exacerbated by any forms of traumatization of their sinal mucosa. During paroxysms of asthma associated with sinus infection, apparently the tissue pressure in the sinal mucosa is of a magnitude which is promoting absorption of toxic molecules. If the tissue pressure is increased during this acute phase by intranasal antrotomy and the introduction of a self-retaining catheter or a pressure balloon, the resulting increased tissue pressure may accelerate absorption of toxic substances, increase the asthma and produce pleurisy or pneumonitis.

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9. Piersol, G. A.: Normal Histology, ed. 2, Philadelphia, J. B. Lippincott Company, 1894, p. 403.

10. Robison (footnotes 6 and 7).

Application of pressure to the mucosa of the maxillary sinuses should be considered as an adjunct to the treatment of allergic sinusitis and not as a substitute for any standard practice. The rhinologist's treatment of the subacute and chronic stages of this disease should begin with removal of any intranasal polypi present and repeated irrigation of the maxillary sinuses if they contain secretion. These procedures alone often suffice to relieve the patient's symptoms and reduce the edema of the sinal mucosa. However, certain of these patients, although symptom free, retain an excess of tissue fluid in their mucosa, which is then susceptible to recurrent infection. Intranasal antrotomy is effective in relieving some of these patients, but it may not reduce the edema of the mucosa. Some patients have had patent antrotomy openings for months, and others, used as controls, have had openings present for years without relief of symptoms or absorption of the mucosa edema.[1] The application of pressure in these controls has left little doubt concerning its therapeutic efficiency. It definitely promoted absorption of excess tissue fluid and relieved the patients' symptoms. Although the application of pressure was devised to accelerate the absorption of stagnant tissue fluid, its use has revealed that certain patients with infectious asthma are greatly benefited by it. In these patients it is applied best in the intervals between their infections and paroxysms of asthma. On reduction of the susceptibility of the sinal mucosa to recurrent infection the attacks of asthma become less severe and less numerous, and in certain patients the attacks entirely disappear. The application of pressure should always be accompanied by treatment directed toward decreasing the patient's sensitivity to allergens and increasing his resistance to infection. The latter has been accomplished best by administration of stock, autogenous and viral vaccines over a considerable period, particularly during the quiescent intervals between infectious stages.

Difficulties encountered during the application of pressure may usually be classed in one or another of the following groups:

1. Temperament of the patient. Patients react to balloons in their sinuses in direct proportion to how long they have had allergic sinusitis and how severe their symptoms have been. If their symptoms are of recent origin and consist principally of subacute allergic rhinitis, they may complain of comparatively trivial discomforts, such as a slight odor from crusting around the tube in the nose, but if their symptoms are of long duration and are associated with asthma, cough, rales and nasal polypi, they rarely complain of any discomfort. This is particularly true of those who have had extensive treatment for allergy and sinusitis without relief and are faced with the alternative of radical sinusotomy, which too often may afford them only temporary relief.

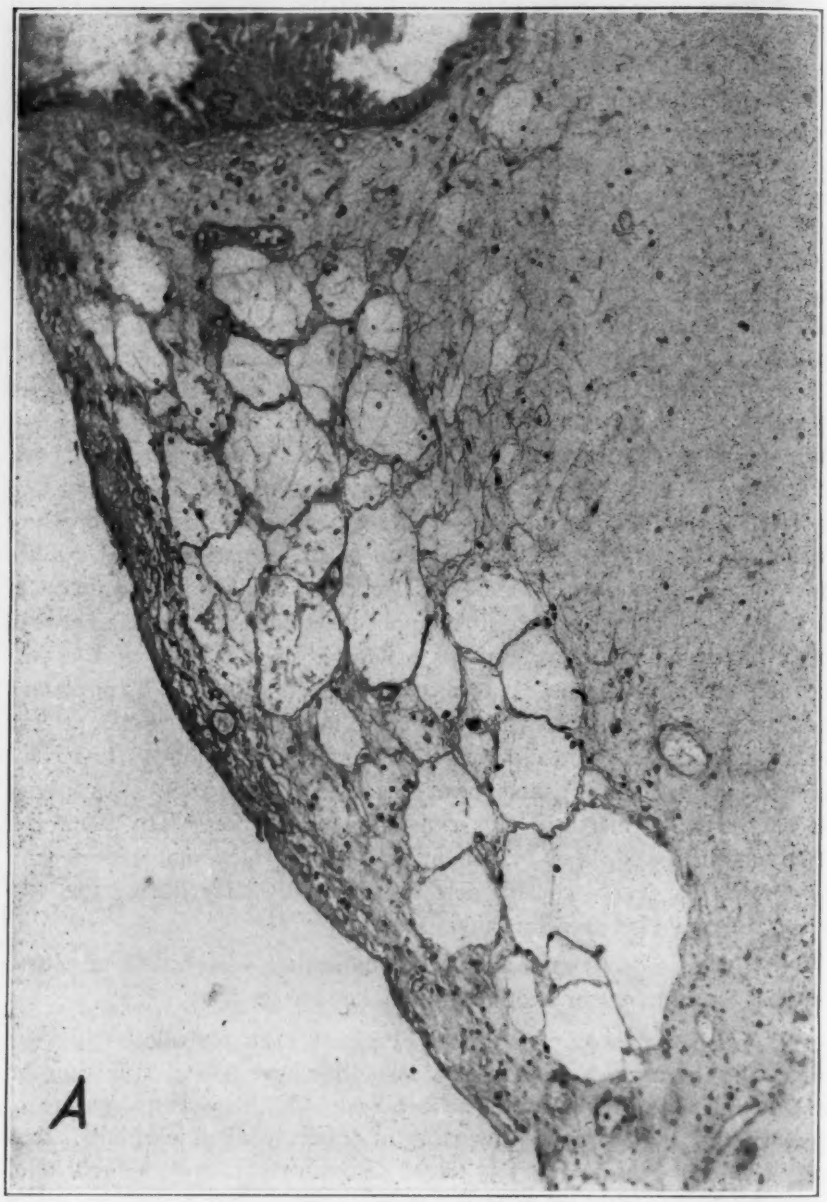

Fig. 9—Photomicrographs showing two polypi removed from the left middle meatus of patient J. K. Both sections were taken from the most dependent portions of the polypi. Polypus *A* was removed before the application of pressure and had been formed slowly by pathologic processes operating over a protracted period. The vacuolated appearance is due to dilation of tissue spaces following gravitation of interstitial fluid. This fluid may disrupt the interstitial fibrils and collect in

puddles, comparable to lake formation in a swamp. At times it may be aspirated by needle puncture and may contain bacteria. Polypus *B* was removed after pressure had been applied to the mucosa of the patient's maxillary sinus for six weeks. The homogeneous appearance of the stroma is due to disruption of the interstitial fibrils by the comparatively rapid movement of the interstitial fluid resulting from hydrostatic pressure applied to the edematous mucosa of the maxillary sinus.

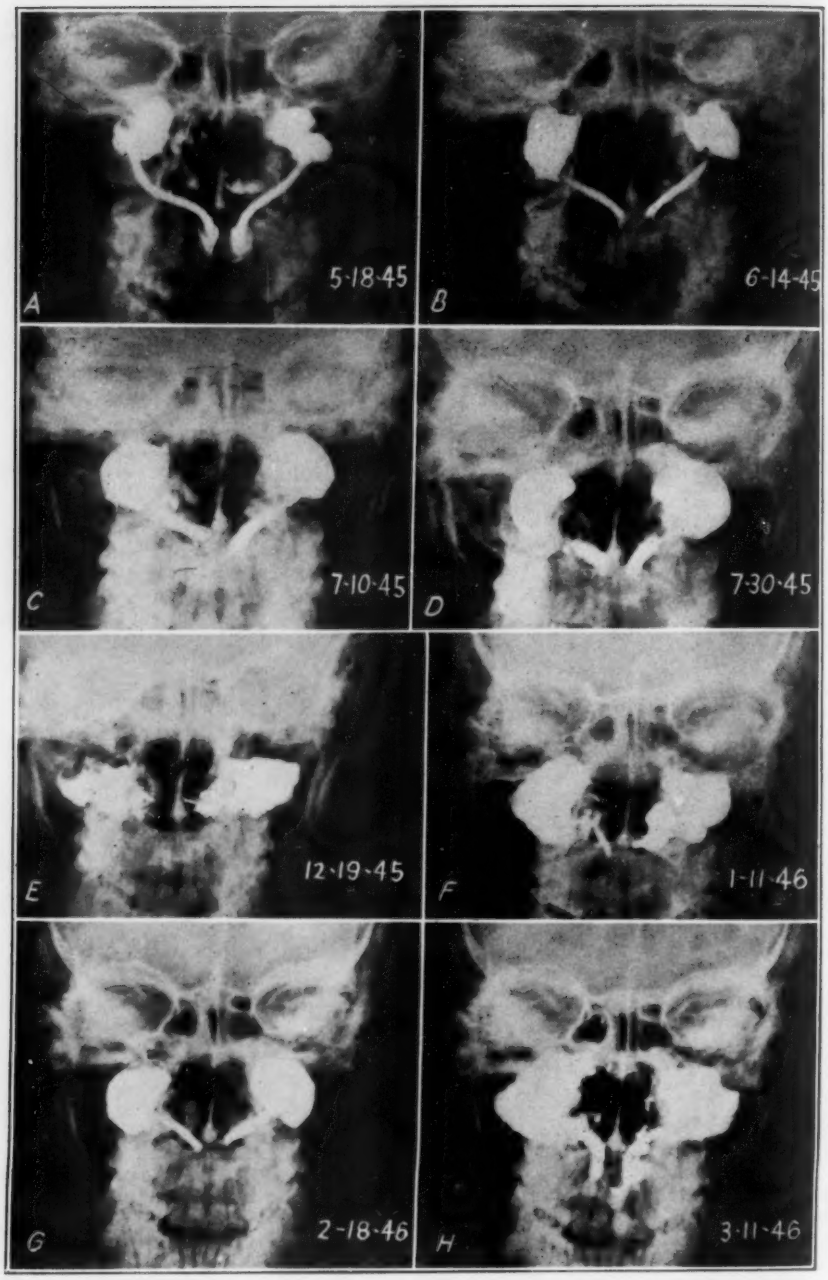

Figure 10

(See legend on opposite page)

2. Application of excessive pressure. Usually this occurs when the physician fails to take into consideration the degree of swelling of which the sinal mucosa is capable when irritated or infected. If a pressure balloon is inflated to comfortable pressure in a maxillary sinus whose mucosa is capable of increased swelling, the irritation of the balloon may cause enough additional edema to produce discomfort or pain. Therefore it is important, unless one knows the degree of fibrosis present in the mucosa of a certain maxillary sinus, not to inflate the balloon until after it has been in the sinus for two or three days. When the balloon has been inflated, thick, viscid secretion which may not be displaced readily may be displaced after a few hours, and thus the intrasinal pressure is reduced and the purpose of the inflation defeated.

3. Infection; closure of the antrotomy opening. Infection may be carried into the maxillary sinus with the balloon when it is inserted. This becomes manifest by development of sensations of marked pressure and at times pain in the sinus, with purulent secretion draining from the sinus. This accidental infection often subsides promptly but may frequently be avoided by instilling 2 cc. of saline solution containing 5,000 units of penicillin into the sinus before the balloon is inserted. A small

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Fig. 10.—Patient A. B., aged 48 years, had a nonallergic history and did not react to cutaneous tests. She had had nasal difficulties for twenty-three years, and for the past eight years she had had nasal stenosis, bronchitis and at intervals nocturnal bronchial asthma. For the last two months she had suffered from asthma constantly. She had been under the care of a competent allergist, who had been giving her autogenous and stock vaccines for the last year. Examination showed small polypi in her middle meatuses and bilateral thickening of the mucosa of her maxillary sinuses. Repeated puncture and irrigation of her maxillary sinuses evacuated mucopurulent secretion. After polypectomy and intranasal antrotomy, her maxillary sinuses were irrigated, and antibiotics were administered locally and systemically for three weeks, without her nasal stenosis, bronchitis and asthma being relieved. Balloons were then inserted in her maxillary sinuses and inflated with iodized oil. She had an exacerbation of her asthma for forty-eight hours, and then her symptoms subsided completely. The balloons were left in place for about ten weeks (*A*, roentgenogram taken May 18, 1945, and *D*, taken July 30, 1945). Large newly formed polypi appeared in her middle meatuses. During this period she "took cold" and suffered from nasal stenosis for one week, but neither bronchitis nor asthma developed. After removal of the balloons she remained free of symptoms for five months. Then she "took cold" and had nasal stenosis, bronchitis and severe asthma for five days. After sinal irrigations and local and systemic administration of antibiotics her asthma and bronchitis subsided, but she continued to have nasal stenosis, nasal intonation of the voice and occasional mild paroxysms of nocturnal asthma (*E*, taken Dec. 19, 1945; oil had been instilled in the sinuses without use of balloons). Balloons were reinserted and left in place for five weeks, with complete relief of her nasal and asthmatic symptoms (*F*, taken Jan. 11, 1946, and *G*, taken Feb. 18, 1946). *H* was taken about three weeks after removal of the balloons. The iodized oil is held in the sinuses by self-retaining catheters in the antrotomy openings. This patient has remained entirely symptom free until the time of writing (Oct. 2, 1946). Her middle meatuses appear normal, and she has no excess secretion in her maxillary sinuses.

antrotomy opening may tend to close before the balloon is inserted. When this occurs, it is usually permissible to enlarge the opening slightly to admit the balloon. However, this should be done only if the first operation was performed as long as two weeks previously. There is no more dangerous intranasal procedure than that of operating frequently on the

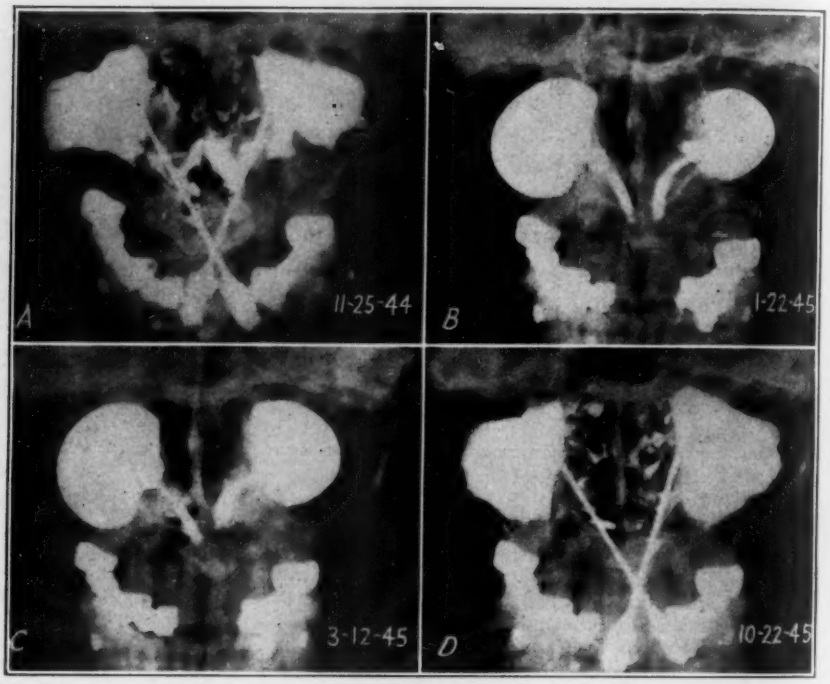

Fig. 11.—Patient J. A. T., aged 55, had an allergic history of fourteen years' duration and allergic sinusitis. He had frequent attacks of bronchitis, nasal stenosis and bronchial asthma. The last had become increasingly more frequent and severe. On first examination he had small polypi in his middle meatuses, bilateral thickening of the mucosa of the maxillary sinus (*A*, roentgenogram taken Nov. 25, 1944) and asthma of two months' duration, for which he had been treated by a competent allergist. Puncture and irrigation of the maxillary sinuses evacuated mucopurulent secretion. The small polypi were removed, nasoantral windows were made and the sinuses were irrigated at intervals for three weeks, without the patient's gaining relief from his asthmatic symptoms. Balloons were then inserted into the maxillary sinuses and inflated with iodized oil. The pressure was continued in the sinuses for about three months. He was relieved of bronchitis, nasal stenosis and asthma and gained 10 pounds (4.5 Kg.) (*B*, taken Jan. 22, 1945, and *C*, taken March 12, 1945). During this period large, newly formed polypi appeared in the middle meatuses. The patient was symptom free for seven months; then he "took cold" and had bronchitis, nasal stenosis and asthma for three days, which was so mild that medication was unnecessary. The sinuses were irrigated at this time and a small amount of secretion was evacuated (*D*, taken Oct. 22, 1945). One month later, although the patient was entirely free of symptoms, the balloons were reinserted and left in place for eight weeks. Since that time the middle meatuses have appeared normal, the sinuses have been free of excess secretion and to the time of writing (Oct. 2, 1946) the patient has had no symptoms except for one mild respiratory infection.

same area in the nose. The interval should never be less than two weeks. Repeating operations in this area at short intervals is one of the most frequent causes of osteomyelitis of the bones surrounding the sinuses. An antibiotic should be administered as a prophylactic before and after the antrotomy, particularly if the patient is having asthma, and at any other time that infection occurs during the application of pressure.

4. Herniation of the balloon into the nose. This occurs when the opening of the maxillary sinus into the middle meatus is large, the intranasal antrotomy opening is too large, or too much pressure is applied in the balloon. Herniation produces nasal stenosis and may, when it occurs

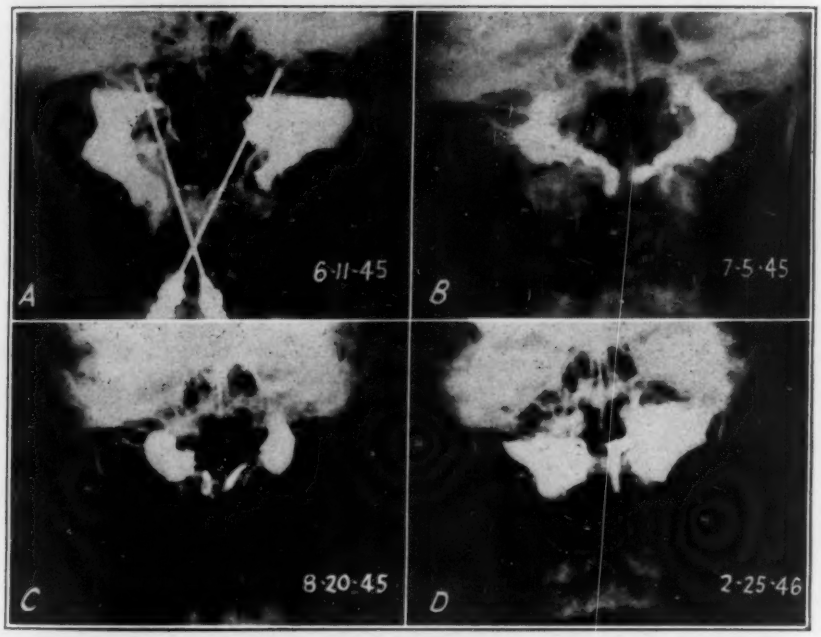

Fig. 12.—Patient L. P., aged 40 years, had suffered for eighteen years from nasal stenosis, excessive postnasal drainage, "sinus trouble," cough, recurrent nasal polypi and loss of weight. Examination showed polypi filling both middle meatuses, and mucopurulent secretion was evacuated from both maxillary sinuses (*A*, roentgenogram taken June 11, 1945). Three weeks after polypectomy and intranasal antrotomy, balloons were inserted into the maxillary sinuses and worn for eight weeks (*B*, taken July 5, 1945, and *C*, taken Aug. 20, 1945). This patient was relieved of her symptoms and has remained symptom free to the time of writing (Oct. 2, 1946). The sinuses were free of secretion and the middle meatuses appeared normal five and one-half months after removal of the balloons (*D*, taken Feb. 25, 1946).

through the middle meatus, produce lymphatic blockage and venous congestion of the anterior group of sinuses, which is manifested by mild symptoms of frontal sinusitis. Herniation through the antrotomy opening may be minimized by using a balloon which contains a self-retaining

catheter head that is of the proper size to occlude completely the intranasal window, and avoiding the application of too much pressure.

5. Nasal stenosis due to swelling of the turbinates. This usually subsides after pressure has been applied to the sinal mucosa long enough to accelerate molecular diffusion in the stagnant tissue fluid. Continuation of nasal stenosis is usually due to boggy turbinal tissue which has lost its contractility, to unremoved or newly formed polypi or to the intranasal end of the catheter if this is too long. As pressure is applied in the maxil-

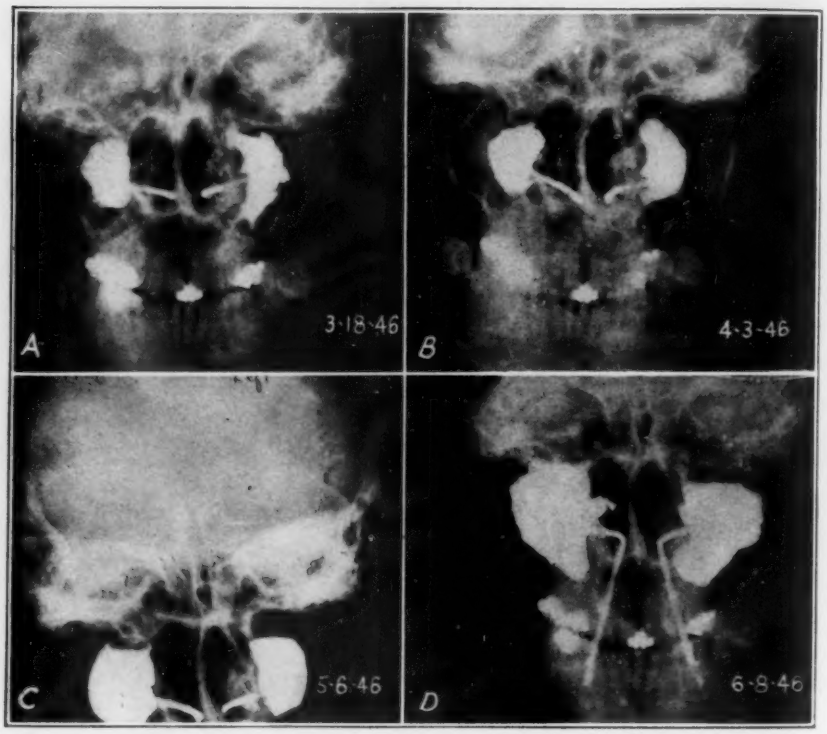

Fig. 13.—Patient R. K. M., aged 50, suffered for ten years from constant nasal stenosis, frequent "head colds," wheezing in his chest, cough and attacks of nocturnal bronchial asthma. On first examination he had polypi filling the middle meatuses, mucopus was evacuated from the maxillary sinuses and many rales were audible. Bilateral polypectomy and intranasal antrotomy were done, and the sinuses were irrigated for six weeks without relief of any of his symptoms except nasal stenosis (*A*, roentgenogram taken March 18, 1946). Balloons were then inserted and pressure applied in the maxillary sinuses for seven weeks. During this period large, newly formed polypi appeared in the middle meatuses (*B*, taken April 3, 1946, and C, taken May 6, 1946). *D* was taken about one month after the balloons were removed (June 8, 1946). The iodized oil is held in the sinuses by closing the antrotomy openings with self-retaining catheters. To the time of writing (Oct. 2, 1946) he has been entirely free of symptoms.

lary sinus, newly formed polypi may appear in the middle meatus, also intranasal polypi may be forced through the ostium into the middle

meatus. The latter may cause strangulation of, or bleeding into, the polypi, either of which may be associated with pain, which may not occur until some time after pressure is applied. This complication has not proved troublesome and is easily relieved by removal of the polypi. Small granulomas which occasionally form around the catheter in the inferior meatus may be removed after the balloon is removed.

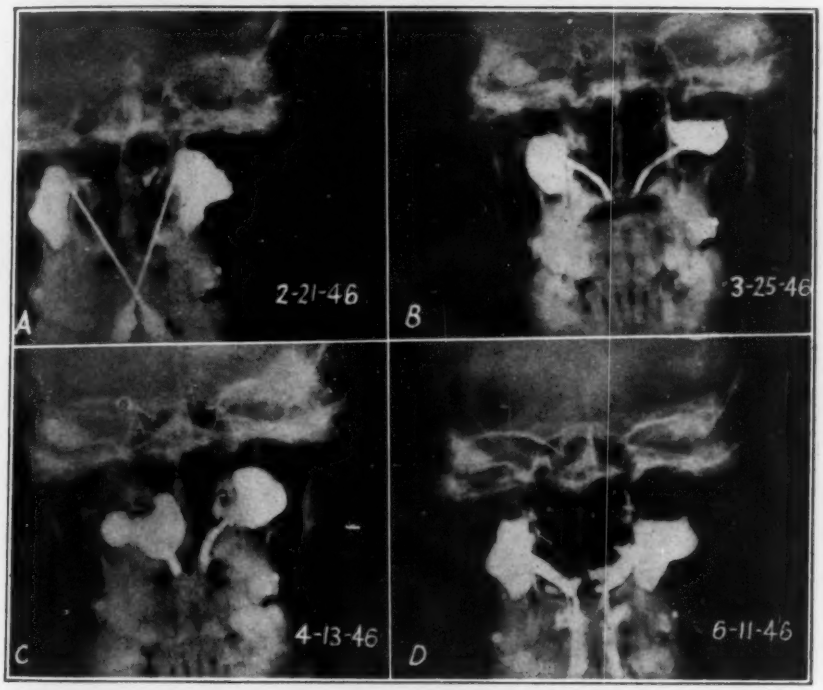

Fig. 14.—Patient J. K., aged 38, had two daughters, two nieces and one brother with hay fever, asthma, nasal polypi and chronic sinus infection. He had suffered with nasal difficulties for eleven years and had known he was allergic for nine years. He was cutaneously sensitive to numerous allergens and had received antiallergic treatment. He complained of hay fever, constant nasal stenosis, cough, loss of weight, severe pains in his face and headache, but had not had asthma. Examination showed complete nasal stenosis due to nasal polypi and swollen turbinates, and the maxillary sinuses contained a large amount of mucopus (*A*, roentgenogram taken Feb. 21, 1946). After bilateral polypectomy and intranasal antrotomy the sinuses were irrigated for one month with lessening of the symptoms of nasal stenosis but with little change in the quantity or the character of the secretion in the sinuses. Balloons were then inserted and left in place for about six weeks (*B*, taken March 25, 1946, and *C*, taken April 13, 1946). In *B* the left balloon has not displaced the secretion in the sinus. In *C* the right balloon herniated on application of excessive pressure, and was replaced. During the application of pressure large, newly formed polypi appeared in the middle meatuses. *D* was taken about one month after the balloons were removed (June 11, 1946). The antrotomy openings are occluded by the funnel ends of the urethral catheters. This patient has been entirely symptom free, and his maxillary sinuses have been free of secretion until the present time (Oct. 2, 1946).

6. Fibrosis. The best results are obtained by applying pressure to the sinal mucosa before extensive fibrosis occurs. Allergic disease of the maxillary sinus frequently has been present for many years before pressure is applied and alternating areas of dilated tissue spaces and newly formed fibroblasts are present in the mucosa.[10] This fibrosis delays absorption and often necessitates the applying of pressure at intervals. The symptom complex of the patient is not proportional to the amount of tissue fluid present in the sinal mucosa. Apparently, it is more in accord with the amount of bacterial, allergic or cellular metabolic substances which the tissue fluid in the mucosa may harbor. Accordingly, pressure

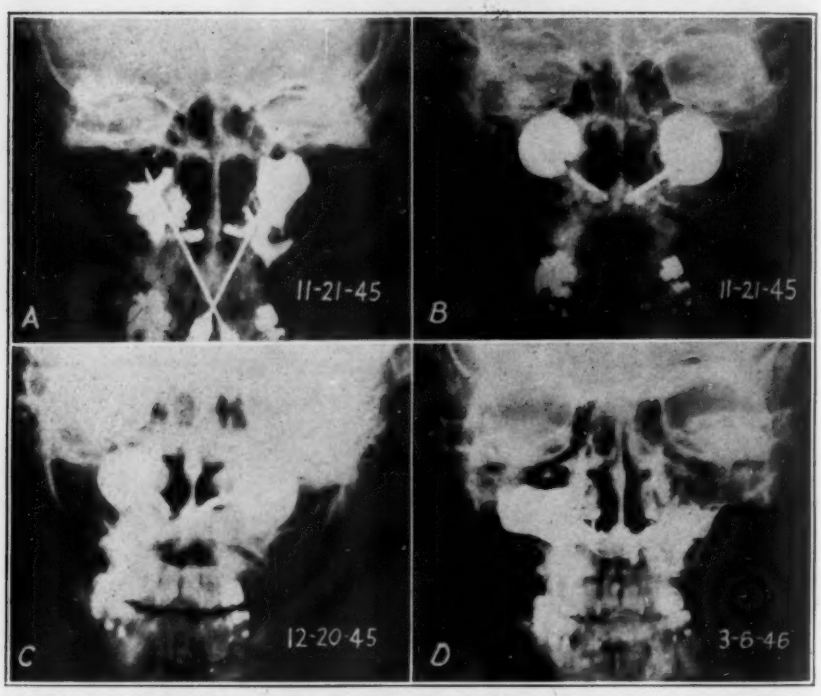

Fig. 15.—Patient R. L. K., aged 41 years, had a nonallergic history but had complained of his nose for twenty-one years. He had suffered from nasal stenosis, excessive nasal drainage, wheezing in his chest and cough, and at intervals had to have nasal polypi removed. Examination showed nasal polypi, rales in the chest and mucopus in both maxillary sinuses (*A*, roentgenogram taken Nov. 21, 1945). He had patent intranasal antrotomy openings, which had been present for four years. After polypectomy and without changing the antrotomy openings, balloons were inserted in the maxillary sinuses and worn for eight weeks (*B*, taken Nov. 21, 1945, and *C*, taken Dec. 20, 1945). He was completely relieved of all his symptoms and has remained symptom free. His middle meatuses have been normal in appearance, and his sinuses have remained free of secretion to the present time (Oct. 2, 1946). *D*, taken six weeks after removal of the balloons (March 6, 1946); oil is held in the sinuses by self-retaining catheters. It was difficult to hold the oil in the left sinus, owing to a large antrotomy opening.

applied to the mucosa may relieve the patient of symptoms even though an excess of extravascular fluid is retained. In certain cases it is desirable

to repeat the application of pressure though the patient is entirely free of symptoms. Although some patients have worn balloons in their sinuses continually for three months, experience has shown that six weeks to two months is probably the optimum time for one application, followed by a rest interval of one to three months. The rest interval may be gaged to some extent by the susceptibility of the patient to repeated infection and the effectiveness of measures instituted to raise his resistance to allergens and infectious agents. The rubber used for the construction of these balloons has shown little tendency to disintegrate on long contact with iodized sesame or peanut oil. When these balloons are produced by various manufacturers, the rubber should be observed for its oil-resisting qualities.

CONCLUSIONS

1. The absorption of extravascular fluid from the mucosa of the paranasal sinuses is related to the tissue pressure which, according to its magnitude, retards capillary filtration and promotes capillary absorption, molecular diffusion and lymph flow.

2. Stagnation of tissue fluid in the sinal mucosa is part of the pathogenesis of subacute and chronic allergic sinusitis. Intermittent attacks of infection are characteristic of the clinical course of the stagnation of tissue fluid in the mucosa and participate in the causation of the progressive degeneration which occurs in the mucosa.

3. Increasing the tissue pressure of the mucosa of the maxillary sinus by application of local pressure to the mucosa by means of a balloon filled with iodized oil accelerates absorption of stagnant tissue fluid and is an important aid in decreasing the incidence of recurrent sinus infection. This procedure stops, interrupts or retards the progress of the pathologic processes in the sinal mucosa.

4. The symptoms occurring during allergic sinusitis apparently are related to the amount and the character of the toxic products present in the tissue fluid of the sinal mucosa and are not directly proportional to the volume of the excess fluid. The application of local pressure to the mucosa of the maxillary sinus relieves certain patients of the symptoms which they manifest during recurrent sinus infection. Patients have been relieved of nasal stenosis due to increased turgescence of the turbinates, recurrence of nasal polypi, excessive secretion of the maxillary sinuses and the bronchopulmonary symptoms of bronchitis, cough and infectious asthma. The duration of this relief is not known, but so far it has continued until the patient is attacked again by an allergic or an infectious agent. Since allergic sinusitis is characterized by progressive pathologic changes which may be present over a protracted period, it is difficult to evaluate properly and often erroneous to judge the ultimate efficiency of

any type of therapy administered and observed over a short span of the patient's lifetime.

5. The difficulties encountered during the application of local pressure to the mucosa of the maxillary sinus may be ascribed to (1) temperament of the patient, (2) application of excessive pressure, (3) infection and closure of the antrotomy opening, (4) herniation of the balloon into the nose, (5) nasal stenosis due to swelling of the turbinates and (6) fibrosis of the mucosa.

6. The application of local pressure to the mucosa of the maxillary sinus should be considered as an adjunct to more conservative treatment of allergic sinusitis and not as a substitute for any standard practice.

The principles of fundamental physiology set forth in the works of Dr. Cecil K. Drinker, professor of physiology at Harvard University, have been cited freely.

Mr. George Neuman and Miss Anne Russel and their associates in the department of medical illustrations gave technical aid in this study.

1304 Walker Avenue.

ABSTRACT OF DISCUSSION

DR. HOMER E. PRINCE, Houston, Texas: During the past three years I have had the privilege of cooperating with Dr. Robison in this study of allergic patients. I have seen his pressure technic give spectacular relief to many with intractable respiratory allergies.

The condition most likely to be benefited by Dr. Robison's procedure is seen in the patient who has a history of allergy and the nasal and laboratory findings of allergy but in whom no definite causative factors can be found by the allergist by cutaneous test, dietary manipulation or therapeutic trial. Bacterial infection is present as a complication of preexisting allergy or as the primary allergenic factor. Furthermore, in the past many of my patients in this category have not been relieved by management of the otolaryngologist using local treatment, displacement, drainage procedures or radical surgical procedures.

As Dr. Robison has pointed out, many of these patients have asthma. It is interesting to note the marked aggravation of the asthmatic condition, as well as the increase in nasal symptoms, following any intranasal manipulation, especially when this is carried out before a quiescent state has been attained. It is therefore evident that sincere, honest cooperation between the allergist and the otolaryngologist is essential.

The selection of cases of allergic sinusitis in which an infectional element is present often taxes the ingenuity of the specialist. When the separation and the proper management of these conditions are made early, there are fewer patients in whom the conditions progress to a chronic stage requiring local intervention.

It must be emphasized that the pressure treatment should not be used indiscriminately. By far, the majority of patients with nasal allergy and accompanying transitory changes in the mucosa of the sinuses can be relieved by an adequate program of treatment of allergy. The cause of the existing condition must be determined and controlled; if allergic, by accepted allergy management; if infectional, by control of the infection.

The more I see of Dr. Robison's work, the more I am convinced that the principles involved in this report are fundamentally sound and offer a practical conservative method of affording relief to a group of patients who have hitherto received little improvemenut from any accepted method of treatment.

Dr. Oscar Swineford Jr., Charlottesville, Va.: I consider this an important contribution. It might be held to be a breath of fresh air in the stale miasma of paranasal pathologic physiology. Dr. Robison has had too little time to present many of the important aspects of his work, which should be of interest to the allergist and to the rhinologist.

Polypoid changes in the nose and sinuses have been problems for a long time. The pathogenesis has been uncertain, the significance of the polyps has been uncertain, and the management of polypoid changes has been rather arbitrary. The older theories for the explanation of polyp formation, such as infectious lymphangitis, local circulatory disturbances, vascular disturbances with or without suppuration, are certainly inadequate. The more recent ideas that polypoid changes are the result of an allergic reaction have been based simply on time relationships or associations with allergic reactions. A mechanism of polyp formation has not been previously described.

Dr. Robison's idea of uneven fibrosis with uneven distention by retained tissue fluid seems a logical explanation of the production of paranasal polyps.

The clinical importance of polyps has been the subject of much discussion. Kern and Schenck showed that approximately 30 per cent of asthmatic patients had nasal polyps, whereas about 65 per cent of membranes removed from the sinuses of asthmatic patients showed polypoid changes.

Dr. Robison's observation of the exacerbation of asthma by acute distention of the sinal mucosa and the relief as a result of sutained pressure certainly confirms the old belief in the relationship between asthma and sinus disease. While Dr. Robison's observations do not explain it, they do, potentially at least, point toward the detection and recognition of this hitherto and still rather nebulous mechanism by which sinus disease causes asthma.

This problem is too important and too wide in its implications to expect one person to solve it. I am sure Dr. Robison is most anxious to have you pursue the lead which he has established. I would recommend to all of you who have not already done so that you see his excellent exhibit in the auditorium.

Dr. J. M. Robison, Houston, Texas: I want to thank Dr. Prince and Dr. Swineford for discussing this paper. These two gentlemen, as you probably know, are allergists. The reason I asked allergists to discuss this paper instead of asking otolaryngologists is that I do not know of any otolaryngologists who have applied local pressure to the mucosa of the maxillary sinus in treating allergic sinusitis. I anticipated that the allergist might give some information concerning the type of allergic patient to whom this treatment might be most applicable. In this paper I did not establish definite criteria for the selection of patients suitable for this form of therapy. These criteria were omitted intentionally because this method of treatment has not been used long enough to establish definitely all of the indications and contraindications for its use. The cooperation of the allergist has been essential in selecting patients suitable for this type of treatment. So far I have reserved the use of this procedure for those patients whom the allergist has not been able to relieve of certain symptoms and for the progressive pathologic processes associated with allergic sinusitis.

I appreciate the opportunity given me by the officers of the Section of Laryngology, Otology and Rhinology to present this subject for your consideration.

FRIEDLAENDER'S BACILLUS MENINGITIS SECONDARY TO OTITIS MEDIA

A Report of a Case with Recovery and a Review of the Literature

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THE OBJECT in presenting the following material is to review all the available cases of Friedländer bacillus meningitis secondary to otitis media. One case with recovery will be reported as the second to be recorded in the literature. Therapeutic methods used up to the present time will be summarized.

BACTERIOLOGY

Friedländer originally described the bacillus now commonly known as Friedländer's bacillus, in 1883, as the causative agent of pneumonia. Today the incidence of Friedländer's bacillus as an etiologic agent of primary pneumonia is known to be low. Since its discovery the organism has been known as Bacterium pneumoniae, Bacterium Friedländeri, Bacillus mucosus capsulatus, Encapsulatus pneumoniae and Klebsiella pneumoniae.

Current texts (Jordan and Burrows,[1] Zinsser[2] and Julianelle[3]) describe the bacillus as a short, plump rod subject to variations in size. It is a nonmotile, non-spore-forming, unflagellated, facultative anaerobe whose optimum temperature is 37.0 C. A well developed capsule surrounds the bacillus, and two or more organisms may be enclosed in one capsule. It is gram-negative.

Nutritive requirements are exceedingly simple, as it grows luxuriantly on ordinary simple mediums to form gray-white mucus-like colonies, slimy in appearance on agar and forming nail-like suspensions in stabs.

There is great variability in the fermentative activity of the different strains, and it has been well shown that the classification of strains of Friedländer's bacillus on the basis of fermentative activity is of little value.[3]

From the Otorhinolaryngological Service, Presbyterian Hospital, New York.

1. Jordan, E. O., and Burrows, W.: Textbook of Bacteriology, Philadelphia, W. B. Saunders Company, 1945.

2. Zinsser, R. H., and Bayne-Jones, S.: Textbook of Bacteriology, New York, D. Appleton-Century Company, Inc., 1939.

3. Julianelle, L. A.: The Distribution of Friedländer's Bacilli of Different Types, J. Exper. Med. **52**:539-545, 1930.

Julianelle [3] has succeeded in dissociating cultures of Friedländer's bacillus into a smooth, or virulent, encapsulated form and a rough, non-encapsulated form lacking in virulence.

PATHOGENICITY

The organism is a pathogen associated with extensive and spreading suppurations of the body. It is not too rare to find it in septicemias, hepatic abscesses, meningitides, pelvic and subphrenic abscesses and intra-abdominal infections following intestinal perforation, as well as in the upper and lower respiratory tracts.

CLASSIFICATION

Julianelle [3] has divided strains of Friedländer's bacillus into three sharply defined immunologic groups, namely A, B and C, with a heterogenous group X. The incidence of occurrence is, respectively, 52, 15, 9 and 24 per cent. Group A consists for the most part of strains derived from human sources, while the greatest number of B strains come from animals. X strains have been found in a great variety of diseases. The distinction between the groups were referable to the presence of a specific carbohydrate in the capsular material.

Friedländer's bacillus is closely related to the coliform bacteria. In the Bergey classification the genus Klebsiella has been allocated to the organism, along with Escherichia and Aerobacter (the coliform bacilli). Jordan and Burrows [1] stated that it is better not to insist on such a close relationship, preferring to regard it as a member of the broad genus Bacterium.

IMMUNOLOGICALLY RELATED ORGANISMS

There is a striking parallelism in the immunologic behaviors of pneumococcus and Friedländer's bacillus.[2] The serums of B strains of Friedländer's bacillus will protect mice against Pneumococcus II infection and vice versa, although the capsules of the two organisms are not chemically identical (Morris and Julianelle [4]). The capsular material of the former is precipitated by barium hydroxide and neutral lead acetate whereas that of Pneumococcus II is not.[5]

The two organisms possess a common accidental antigen causing them to cross-agglutinate, as Morris and Julianelle [4] have shown. This same reaction may be responsible for the close relationship of the bacillus of rhinoscleroma and Friedländer's bacillus, type C, or the two may actually

4. Morris, M. C., and Julianelle, L. A.: A Biologic Classification of the Bacillus of Rhinoscleroma, J. Infect. Dis. **55**:150-155, 1934.

5. Julianelle, L. A.: Immunological Relationships of Cell Constituents of Encapsulatus Pneumoniae (Friedländer's Bacillus), J. Exper. Med. **44**:735-751, 1926.

be identical organisms. Each agglutinates equally well in the other's antiserum; thus the two become immunologically identical. However, in a comparative series of several strains of Friedländer's bacillus and of the bacillus of rhinoscleroma, those of the latter were shown to exhibit a uniformity of behavior uncommon to Friedländer's bacillus.

Julianelle,[6] in a comparative study, found no cross-agglutination reactions with Friedländer's bacillus, the rhinoscleroma bacillus and Pneumococcus II against Klebsiella ozenae.

Friedländer's bacillus is confused with the coli-aerogenes group, as shown by the study of Osterman and Rettger.[7] This may help explain why Bacillus coli infections following intestinal perforations are often reported, as in reality a higher incidence of Friedländer's bacillus in such infections is not uncommon.[8]

OCCURRENCE

Hyde and Hyde,[9] in a review of several series, reached the conclusion that 1 per cent or less of normal throats contained Friedländer's bacilli. In their series of cases of pneumonia at Bellevue Hospital, 1.6 per cent were caused by this organism. They felt, however, that the actual incidence is probably higher. In 79 per cent of their cases the sputum typing revealed group A. Group B was present in only 4 per cent. This correlates with the finding of Julianelle [3] that group A strains are isolated mostly from man.

The organism is common in the nasopharynx of patients with chronic sinusitis and bronchiectasis and is associated with suppurative conditions of various parts of the body.

In 198 cases of Friedländer's bacillus infection of the body compiled by Baehr, Shwartzman and Greenspan [8] the gastrointestinal tract was most frequently involved. Following in diminishing frequency of involvement were the genitourinary tract, the biliary passages and the liver, and the lungs, including the upper respiratory tract. Involvements of the skin and the meninges were placed with miscellaneous infections, which occurred in 10 of the 198 cases. Only 2 cases of pneumonia due to this organism were encountered at the Mount Sinai Hospital, New York, in thirty-six years.

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6. J. Julianelle, L. A.: A Biological Classification of Klebsiella Ozenae, J. Bact. **30**:535-543, 1935.

7. Osterman, E., and Rettger, L. F.: A Comparative Study of Organisms of Friedländer and Coli-Aerogenes Groups, J. Bact. **42**:699-719 and 721-743, 1941.

8. Baehr, G.; Shwartzman, G., and Greenspan, E. B.: Bacillus Friedländer Infection, Ann. Int. Med. **10**:1788-1801, 1937.

9. Hyde, L., and Hyde, B.: Primary Friedländer Pneumonia, Am. J. M. Sc. **205**:660, 1943.

In 30 cases of hepatic abscess, Friedländer's bacillus was found by Kinney and Ginsberg [10] in 7, or 23 per cent. Only in 1 case did the strain belong to group A.

Keefer [11] made bacteriologic studies in 32 of 75 cases of hepatic abscess, in which the organism was not found to be an etiologic agent.

Primary meningitis due to Friedländer's bacillus has been reported; however, the cases are few.[12] Secondary meningitis is more common than meningitis with no focus demonstrable elsewhere. It remains a common feeling, however, that in cases reported as instances of primary meningitis due to this organism some focus has been overlooked.

Lion and Minvielle [13] reported a case of suppurative meningitis secondary to abscess of the lung. Two cases of secondary meningitis were in the series of 198 cases reported by Baehr, Shwartzman and Greenspan.[8] Comte, Lévy-Bruhl and Dany [14] described a case in which meningitis developed after pneumonia; Friedländer's bacillus was found in the blood, the urine and the spinal fluid. Siredey and de Jong [15] reported a case of fatal meningitis following a sore throat of ten days' duration.

Ransmeier and Major [16] reported that an etiologic analysis of several large series of cases revealed that meningitis was caused by Friedländer's bacillus in only 3 of 3,714 cases.

Septicemia is reported as uncommon. It occurred in 8 per cent of the cases of Baehr, Shwartzman and Greenspan.[8] It appears to influence the prognosis, for in 89 per cent of the cases of pneumonia accompanied by bacteremia in the series of Hyde and Hyde [9] there was no response to therapy.

RELATIONSHIP TO DIABETES MELLITUS

In the cases reviewed the increased incidence of diabetes mellitus in cases of Friedländer's bacillus infection could not be overlooked. Just

10. Kinney, T. D., and Ginsberg, H. S.: Pyogenic Liver Abscesses Due to Klebsiella Pneumoniae (Friedländer's Bacillus), New England J. Med. **228**:145-151, 1943.

11. Keefer, C. S.: Liver Abscess: Review of Eighty-Five Cases, New England J. Med. **211**:21-24, 1934.

12. Jaffe, S. A.: Extrapulmonary Klebsiella Pneumoniae (Friedländer's Bacillus) Infections: Analysis of Literature; Two Unusual Cases with Recovery, J. A. M. A. **122**:292-296 (May 29) 1943.

13. Lion, G., and Minvielle: Suppurating Meningitis with Friedländer's Bacillus, Bull. et mém. Soc. méd. d. hôp. de Paris **48**:286-288, 1924.

14. Comte, Lévy-Bruhl, M., and Dany: Un cas de méningite à pneumobacille de Friedländer avec septicémie, Bull. et mém. Soc. méd. d. hôp. de Paris **47**:139-142, 1931.

15. Siredey, A.; Lemaire, H., and de Jong: Méningite cérébrospinale à pneumobacille de Friedländer, Bull. et mém. Soc. méd. d. hôp. de Paris **36**:258-262 (July 26) 1912.

16. Ransmeier, J. C., and Major, J. W.: Friedländer Bacillus Septicemia and Meningitis: Report of a Case and Autopsy, with an Analysis of Twenty-Nine Cases Collected from the Literature, Arch. Int. Med. **72**:319-328 (Sept.) 1943.

what part this disease plays in influencing bodily resistance in favor of the organism cannot be assured. A relationship appears to exist, however.

Table 1 shows the incidence in some of the cases mentioned in this paper.

FRIEDLAENDER'S BACILLUS AS A CAUSE OF OTITIS MEDIA

Friedländer's bacillus as a cause of otitis media is rare, as Langdon,[17] in 1917, reported no cultures of this organism encountered in an extensive bacteriologic study. In 1929 Hesse [18] reported a series of 276 cases of otitis media, in 1 of which the disease was due to this organism. Page,[19] in 1934, in 300 cases in which material taken from the knife at myringotomy was cultured, found 2 in which Friedländer's bacillus was isolated; both the patients recovered without surgical treatment. Pneumococcus III, which produces an almost identical clinical and pathologic picture, was found to be the etiologic agent in 51 of his cases. He

TABLE 1.—*Incidence of Diabetes Mellitus in Cases of Friedländer's Bacillus Infection*

Author Reporting	Cases Reported	Diabetes Mellitus	Glycosuria	Type of Infection
Ransmeier and Major [16]	30	1	4	Meningitis
Hyde and Hyde [9]	51	5	..	Pneumonia
Robertson [32]	1	1	..	Meningitis
Jaffe [12]	2	1	..	Gangrene
Ghiselin and Robertson—case reported in this paper	1	1	..	Meningitis
Rothschild [26]	1	..	1	Meningitis

makes reference to another series of 300 cases showing no presence of Friedländer's bacillus. In 1935 Altmann [20] reported 7 cases, in 5 of which there was a resort to surgery; all the patients recovered. He expressed the belief that the course, though like that of Pneumococcus III infection, has a better prognosis. This, however, cannot be stated with any degree of assurance because of the limited number of cases of otitis media due to Friedländer's bacillus. Kreutz,[21] in 1937, reported that in a large number of cases studied bacteriologically there were no

17. Langdon, H. K.: The Bacteriology of Mastoiditis, J. Indiana M. A. **10**:342, 1917.

18. Hesse, W.: Beiträge zur Bakteriologie und Klinik akuter Mittelohreiterunger, akuter Mastoiditiden und deren Komplikationen, Ztschr. f. Hals-, Nasen- u. Ohrenh. **22**:372-411, 1929.

19. Page, J. R.: Bacteriology of Acute Infections of the Middle Ear and Mastoid, Arch. Otolaryng. **20**:447-451 (Oct.) 1934.

20. Altmann, F.: Zur Symptomatologie und Klinik der Friedländer Otitis, Monatschr. f. Ohrenh. **69**:513-537, 1935.

21. Kreutz, G. C., and Witter, G. L.: Observations in Three Hundred Cases of Mastoiditis, Ann. Otol., Rhin. & Laryng. **46**:1060-1064, 1937.

cultures of that bacillus. In 1941 Fowler [22] found 10 cases of otitis media, out of 7,459, in which Friedländer's bacillus was cultured. Pneumococcus was present in 334.

In the review of the literature it appeared that the mortality in uncomplicated cases of Friedländer's bacillus infection of the middle ear was low, although in most of them sooner or later there was a resort to surgery.

Infection of the middle ear due to Friedländer's bacillus is usually distinguished by entire absence of symptoms and may proceed until meningitis or some other complication develops. The mastoid structure is found completely destroyed, as a rule, and not uncommonly portions of dural and sinus plates.

The onset is usually insidious, with a sense of fulness of the ear, mild tinnitus and slightly diminished hearing and usually without pain or fever. As Profant [23] asserted in 1938, "what can be considered a mild otitis media can suddenly develop serious complications." The picture is similar to that of Pneumococcus III infection, which also insidiously destroys the mastoid and petrous structures. It is of interest to compare the slow action of these organisms against bone with that against the lung, where tissue breakdown is devastating.

Muckleston,[24] in 1930, presented a case in which there were seven recurrences and showed the insidious manner in which the micro-organisms destroyed bone. Both the dura of the middle cranial fossa and the lateral sinus were exposed. Zange,[25] in 1912, advised immediate operation in all cases before complications arose. From his observations he stated that the organisms multiply rapidly but that the local reaction of the surrounding tissue is slight. The discharge is mucoid and rich in Friedländer's bacilli but low in fibrin and leukocytes.

MENINGITIS COMPLICATING INFECTION OF THE MIDDLE EAR, BOTH DUE TO FRIEDLAENDER'S BACILLUS

The number of proved cases of meningitis due to Friedländer's bacillus complicating infection of the middle ear due to the same cause is small. The largest series of cases of otogenous meningitis reported consisted

22. Fowler, E. P., Jr.: The Bacteriology of Acute Otitis Media and Its Course Under New and Old Methods of Treatment, Canad. M. A. J. **44**:372-380, 1941.

23. Profant, H. J.: Mastoiditis Caused by Friedländer's Bacillus, Ann. Otol., Rhin. & Laryng. **47**:379-383, 1938.

24. Muckleston, H. S.: Notes on Recurrent Mastoiditis: Report of a Case of Bacillus Mucosus Capsulatus Infection, Tr. Am. Laryng., Rhin. & Otol. Soc. **36**:500-505, 1930.

25. Zange, J.: Ueber die durch das Bakterium pneumoniae Friedländer hervorgerufene Otitis media acuta, ihre Prognose und Therapie, Arch. f. Ohrenh. **89**:1-16, 1912.

of 7 of 30 cases of meningitis due to Friedländer's bacillus presented by Ransmeier and Major [16] in 1943. Of the patients, only Rothschild's [26] recovered; a simple mastoidectomy was done twenty-four days before the onset of meningitis and a diagnosis of abscess of the brain established. Our patient was the second to recover.

Ransmeier and Major [16] in their series of 30 cases of meningitis found that in over half of the adult patients the primary focus consisted in an infection of the middle ear, the cells of the mastoid process and the sinuses.

Guinon and Simon [27] observed meningitis caused by Friedländer's organism in a 5 year old child. Deafness was noted at the time of admission, and otitis media developed on the right side seventeen days

TABLE 2.—*Cases of Otogenous Meningitis Due to Friedländer's Bacillus*

Case	Reported by	Year	Sex	Age	Termination
1	Weichselbaum, A.: Monatschr. f. Ohrenh. **122**:200 and 229, 1888	1888	F	54	Death
2	Brunner, C.: München. med. Wchnschr. **43**: 286 and 318, 1896	1896	M	55	Death
3	Scheib, A.: Prag. med. Wchnschr. **25**: 169-171, 1900	1900	..	9	Death
4	Bonhoff, H., and Esch, P.: Ztschr. f. Geburtsh. u. Gynäk. **70**: 886-894, 1912	1912	..	Newborn	Death
5	Zange [25]	1912	M	61	Death
6	Zange [25]	1912	M	28	Death
7	Rénon, L., and Blamoutier, P.: Ann. de méd. **9**: 119-122, 1921	1921	F	44	Death
8	Brain, W. R., and Valentine, F. C. O.: Lancet **1**: 855-856, 1928	1928	M	22	Death
9	Hesse [18]	1929	M	15	Death
10	Malis [28]	1930	M	5	Death
11	Rothschild [26]	1931	M	34	Recovery
12	Gowen, G. H.: Illinois M. J. **65**: 533-535, 1934	1934	F	63	Death
13	Baehr, Shwartzman and Greenspan [8]	1937	..	..	Death
14	Robertson and Ghiselin	1945	M	48	Recovery

after the organisms were isolated from the spinal fluid. No culture of material from the involved ear is reported; so, in spite of the fact that the patient recovered, the case cannot be included in this series.

Malis [28] reported a case of meningeal irritation following acute otitis media of four months' duration. Blood cultures were positive; however, the patient recovered after simple mastoidectomy and ligation of the right jugular vein. Malis stated that if Friedländer's organisms are found in the spinal fluid, a bilateral mastoidectomy should be done without consideration of the condition of the drums. This is true if other foci have been eliminated and there is roentgenographic evidence of mastoiditis.

26. Rothschild, K.: Meningitis Caused by Friedländer's Bacillus: A Case with Recovery, J. A. M. A. **97**:1956-1959 (Dec. 26) 1931.

27. Guinon, L., and Simon, G.: Méningite cérébrospinale à pneumobacille de Friedländer, Bull. et mém. Soc. méd. d. hôp. de Paris **30**:501-506, 1910.

28. Malis, S.: Pneumobacillus (Friedländer's) Meningitis Secondary to Otitis Media: Report of Two Cases, Arch. Otolaryng. **12**:162-174 (Aug.) 1930.

RÉSUMÉ OF THE CASES REPORTED

Some of the case summaries lack certain data because of the brevity of the original presentations.

CASE 1.—The patient had a preexisting otitis media and died of meningitis two and one-half months after onset. Friedländer's organisms were isolated from the middle ear and the spinal fluid at autopsy.

CASE 2.—Forty-five days after the onset of acute otitis the patient died of meningitis. Friedländer's organisms were found in both the spinal fluid and the aural discharge.

CASE 3.—Acute otitis developed, followed by onset of meningitis. Friedländer's organisms were isolated from the spinal fluid; however, because of the absence of a perforation in the drum membrane, none were found in the middle ear until autopsy.

CASE 4.—Meningitis developed five days after birth, and the patient died in two weeks of purulent meningitis. At autopsy the right middle ear was found full of pus, and Friedländer's bacilli were identified. Those organisms were found also in the spinal fluid.

CASE 5.—The patient had a spontaneous perforation of the drum membrane but no fever. At the sign of meningeal irritation with increased spinal fluid pressure, mastoidectomy was performed ten weeks after the onset of otitis. The bone was considerably destroyed, and the intact dura was opened to relieve elevated spinal fluid pressure. Purulent meningitis developed four days later. A second operation was performed to drain an abscess of the jugular bulb. Death followed two and one-half months after onset. Cultures of aural material and of spinal fluid were positive for Friedländer's bacillus.

CASE 6.—Acute otitis media developed, which progressed insidiously. Exacerbations of toxicity and high fever appeared, with remission. The ear looked so unobtrusive that at first it was not considered as a focus of the infection causing the meningeal symptoms. The patient later underwent simple mastoidectomy, which showed pus present in the mastoid cells, which when cultured yielded a pure growth of Friedländer's bacillus. Cloudy fluid was obtained from the area of dural exposure. Meningeal symptoms increased after the operation, and the patient died one month later. Organisms had been demonstrated in both the aural content and the spinal fluid soon after onset.

CASE 7.—Since childhood the patient had experienced difficulty in hearing on the left side. Six months before she was admitted, at the age of 44, a sharp pain developed on that side of the head. At the time of her admission acute headaches were present. She died four days later before surgical intervention had been contemplated. On two occasions spinal fluid obtained by lumbar puncture showed the organisms. At autopsy the whole internal ear was found to have been destroyed and contained a spongelike mass of pus which extended along the internal auditory canal. Friedländer's bacilli were readily demonstrated to be present in the inner ear, although no pus or organisms were found in the middle ear.

CASE 8.—There was otorrhea on the right side for eight days, at the end of which time simple mastoidectomy was performed. About three years later the ear again discharged; a revision was performed, and dura exposed. Full recovery was apparent eight months later. However, the patient died of meningitis during

an infection of the upper respiratory tract with no obvious involvement of the ear. Friedländer's bacilli were demonstrated in both the blood and the spinal fluid before death.

The meningitis in this case may be attributed to a focus which lay latent either in the old mastoid cavity or in the paranasal sinuses or the pharynx. Since there is doubt as to the actual primary focus, the case should be listed as doubtful.

CASE 9.—Acute otitis developed and Friedländer's bacilli were demonstrated in cultures. Six weeks after onset death occurred from meningitis. The organisms were demonstrated in the spinal fluid.

CASE 10.—As a result of an infection of the upper respiratory tract, pain developed in the patient's right ear. Paracentesis was performed, and the purulent discharge was slight. Two days after onset, symptoms of meningitis appeared, and culture of fluid obtained by lumbar puncture revealed Friedländer's bacilli. Four days after onset, acute diffuse labyrinthitis was suspected, and operation revealed extensive necrosis of the bony intercellular septums of the mastoid process. The dura under the bone was red and tense. Death followed.

CASE 11.—As a consequence of swimming on Aug. 6. 1930, the patient had acute otitis media. Paracentesis was performed September 24, followed by a simple mastoidectomy October 5. On October 29 meningitis appeared, and a diagnosis of brain abscess was made. The next day a subdural abscess was found. On November 8 the wound was explored, and pus was found in the cavity of the mastoidectomy. The patient recovered and was discharged November 14. He was well when seen the following May.

CASE 12.—Three weeks after influenza the patient had bilateral pain in the area of the mastoid process, first with the development of left, then right, acute otitis media. Slow drainage of a mucoid material occurred, and four months later simple mastoidectomy was done on the right side. An abscess developed beneath the corresponding sternocleidomastoid muscle. This was explored about the time meningitis appeared, three months later. The autopsy revealed acute purulent leptomeningitis with bilateral thrombosis of the superior petrosal and cavernous sinuses.

CASE 13.—In a patient with surgical mastoiditis meningitis and septicemia developed, all bacteriologically due to Friedländer's bacilli. Death followed.

REPORT OF AUTHORS' CASE

CASE 14.—A. D., a 48 year old Negro man, seen in the clinic on March 26, 1945, complained of pain and of discharge of blood and pus from the right ear of seven days' duration. From material taken for culture Bacillus aerogenes grew. The drum was red and full, and the discharge thick and yellow-purulent in nature. No tenderness was noted over the mastoid process. The nasal mucosa was congested. He was not seen again until May 29, when the right drum and canal were normal.

Three months after the initial episode, on June 26, the patient complained again of pain in the right ear, of ten days' duration. Some bulging of the superior-posterior wall of the external canal was noted in the canal's external portion. Tenderness was present on manipulation of the pinna, but no discharge was noted. The drum could not be visualized. Incision and drainage of the canal were per-

formed, and culture of the material showed Friedländer's bacillus and Streptococcus viridans. Roentgen examination at that time was reported as indicating a poorly pneumatized, sclerotic mastoid process. The patient was advised to return to the clinic on the following day but failed to do so.

On July 7 the patient was admitted to the Presbyterian Hospital, having been discovered unconscious at home. Physical examination revealed a very ill man, with rigidity of the spine and hot, dry skin. His temperature was 104 F. The right ear was dry with a posterior-superior bulge filling the canal. The white blood count revealed 15,150 neutrophils, of which 85 per cent were polymorphonuclears. The spinal fluid count was 1,600 white blood cells, with 60 per cent polymorphonuclears. The pressure was 45 mm. of water, and the fluid was opalescent. No bacteria were seen on stained smears, but culture was later reported as yielding a pure growth of Friedländer's bacillus. The patient, known to have been diabetic since 1937, had a carbon dioxide-combining power of 61 volumes per cent and a blood sugar content of 286 mg. per hundred cubic centimeters.

Simple mastoidectomy was performed with the patient under pentothal sodium anesthesia, on July 8. The entire mastoid region was found destroyed and the cavity filled with a mucoid pus. A large perforation of the posterior bony canal wall was present, leading into the mastoid cavity. Near the sinodural angle, a small perforation was seen in the dural plate from which pus was escaping under pressure. The bone over the dura and the sigmoid sinus was removed, under which pus and granulation tissue were found. Growth of Friedländer's bacillus was later reported from two cultures taken at operation. Postoperatively, 100,000 units of penicillin was given in a liter of 5 per cent dextrose and saline solution over a period of four hours. The drug was then given in 15,000 unit doses every three hours for one week intramuscularly. Intravenous injections of sulfadiazine were also started and were followed by oral doses after the patient responded. A therapeutic blood level around 10 mg. per hundred cubic centimeters was maintained.

On the following day the patient was rational, and his temperature was on the decline. His white blood cell count and sedimentation rate gradually returned to normal during the postoperative period, and all clinical evidence of meningitis had disappeared within a few days. On July 16 a culture of the mastoidectomy wound revealed no Friedländer's bacilli. The causative organism was not found at any time on repeated culture of material from the throat.

On July 30 the patient was discharged from the hospital to the outpatient clinic. On December 14, nine months after the initial infection, he was seen, and the postauricular wound was well healed, and the drum and canal were normal. The hearing was diminished only a few decibels, and there were no complaints on the part of the patient.

In the interim Miss Helen Erhorn, of Halloran General Hospital, typed the strain of Friedländer's bacillus and reported it as belonging to group A.

THERAPEUTIC ADVANCES

Surgical drainage, iodides, autovaccines and specific serums have been used against Friedländer's bacillus without encouraging results.[12] Abrami and Worms [29] reported, in 1930, the first cure of septicemia due

29. Abrami, P., and Worms, R.: Septicémie à pneumobacilles de Friedländer avec localisation pulmonaire, Bull. et mém. Soc. méd. d. hôp. de Paris **54**:479-486, 1930.

to that organism; acriflavine hydrochloride had been administered intravenously.

Hyde and Hyde [9] stated that treatment of Friedländer's bacillus pneumonia with any of the sulfonamide compounds is of questionable value in most cases. Reports of sporadic cases showing favorable results with the sulfonamide drugs have appeared in the literature.[30]

Brown [31] succeeded in abolishing expectoration aggravated by colds in a case of pulmonary abscess containing this organism. He used sulfanilamide. Recovery in a case of Friedländer's bacillus meningitis secondary to maxillary sinusitis was reported by Robertson.[32] The patient, who had diabetes mellitis, received an autogenous vaccine in addition to sulfapyridine.

Turnbull [33] and Meyer and Amtman [34] reported successes attained in 2 cases of septicemia with sulfadiazine and sulfapyridine, respectively. In the first case the patient received, in addition, blood from donors who had been given a vaccine of killed organisms.

Experimental work by Sesler and Schmidt [35] showing the comparative activity of sulfonamide compounds against Friedländer's bacillus infections in mice resulted in 100 per cent cures with sulfadiazine, 72 per cent with sulfapyrazine and only 3 per cent with sulfathiazole, sulfapyridine and sulfanilamide. The effectiveness varied considerably with the strain, however. Feinstone and co-workers [36] indicated that sulfadiazine shows considerable activity against the bacillus in mice; more than sulfanilamide, sulfapyridine or sulfathiazole. Other experimental evidence [37]

30. Solomon, S.: Chronic Friedländer Infections of Lungs: Report on Seventeen Cases and Observations on Therapy with Sulfapyridine and Sulfanilamide, J. A. M. A. **115**:1521-1536 (Nov. 2) 1940.

31. Brown, P. K.: Sulfanilamid: A Specific for the Friedländer's Bacillus, California & West. Med. **49**:144, 1938.

32. Robertson, C. W.: Meningitis Due to Friedländer's Bacillus: Recovery of a Case Treated with Sulfapyridine, Canad. M. A. J. **45**:70-71, 1941.

33. Turnbull, G. C.: Treatment of Friedländer's Septicemia by Sulfadiazine with Recovery, Illinois M. J. **81**:412-414, 1942.

34. Meyer, K. A., and Amtman, L.: Treatment of Friedländer's Bacillus Septicemia by Sulfapyridine with Recovery, J. A. M. A. **113**:1641-1642 (Oct. 28) 1939.

35. Sesler, C. L., and Schmidt, L. H.: Comparative Activity of Sulfonamides Against Klebsiella Pneumoniae (Friedländer's Bacillus), J. Pharmacol. & Exper. Therap. **79**:117-126, 1943.

36. Feinstone, W. H.; Williams, R. D.; Wolff, R. T.; Huntington, E., and Crossley M. L.: Toxicity, Absorption and Chemotherapeutic Activity of Two-Sulfanilamidopyrimidine (Sulfadiazine), Bull. Johns Hopkins Hosp. **67**:427-457, 1940.

37. Long, P. H., and Bliss, E. H.: The Clinical and Experimental Use of Sulfanilamide, Sulfapyridine and Allied Compounds, New York, The Macmillan Company, 1939, p. 36.

shows sulfapyridine to be considerably better than sulfanilamide; the former protects mice better against Friedländer's bacillus than against Pneumococcus. The number of cases is too few to establish conclusive evidence of the effectiveness of the sulfonamide drugs.

Penicillin was shown to be ineffective by Hobby, Meyer and Chaffee,[38] while a slight inhibitory effect was demonstrated by Abraham and associates [39]—however, in impracticable concentrations.

Heilman [40] demonstrated a marked protective effect of streptomycin for mice inoculated intra-abdominally with three different strains of the organism. More prolonged treatment was necessary in order to obtain protection when mice were infected by the intranasal route. Miss Balbina Johnson, of Dr. Meleney's laboratory at the Presbyterian Hospital Medical Center, New York, found the strain of Friedländer's bacillus from our case to be markedly sensitive to streptomycin in tests in vitro.

COMMENT

The most outstanding feature of Friedländer's bacillus mastoiditis in the cases reviewed was the latency with which the micro-organism insidiously destroyed bone. Growth is slow, and the process of destruction can become widespread with vague clinical symptoms or no symptoms at all. The dura of adjacent cranial fossae is often exposed, as well as the sigmoid sinus, sometimes as far as the jugular bulb. Diffuse granulations are nearly always superimposed on these areas. It is not at all uncommon to find abscesses of the sigmoid sinus with thrombosis; pus may be present in either subdural or epidural strata.

The picture shows marked similarity to that of the typical Pneumococcus III infection,[41] and it can be stated almost assuredly that a diagnosis of one or the other will be made at operation before the bacteriologic study has been completed.

From the bit of evidence ascertained from this study it appears that a pneumatic mastoid process is preponderantly associated with Friedländer's bacillus or Pneumococcus III [41a] infections. The incidence of these

38. Hobby, G. L.; Meyer, K., and Chaffee, E.: Activity of Penicillin in Vitro, Proc. Soc. Exper. Biol. & Med. **50**:277-280, 1942.

39. Abraham, E. P.; Chain, E.: Fletcher, C. M.; Florey, H. W.; Gardner, A. D.; Heatley, N. G., and Jennings, M. A.: Further Observations on Penicillin, Lancet **2**:177-188, 1941.

40. Heilman, F. R.: Streptomycin in the Treatment of Experimental Infections with Micro-Organisms of the Friedländer Group (Klebsiella), Proc. Staff Meet., Mayo Clin. **20**:33-39, 1945.

41. (*a*) Abrahams, B. H., and Bonoff, Z. A.: Streptococcus Mucosus as an Etiologic Factor in Otitis Media and Mastoiditis, Ann. Otol., Rhin. & Laryng. **34**:554-573, 1925. (*b*) Altmann, F., and Waltner, J.: Labyrinthitis Due to Pneumococcus Type 3: Histopathologic Studies, Arch. Otolaryng. **40**:75-91 (Aug.) 1944.

infections in sclerotic mastoid processes was indeed low so far as the available literature signified. By referring to table 2 one may see that the incidence of infection in males was considerably the higher.

Truly the number of cases of this type are far too few to enable us to evaluate the successes of therapeutic measures thus far advanced. However, there is reason to believe because of in vivo and in vitro successes with some of the sulfonamide compounds, especially sulfadiazine, that cure may be established provided therapy is instituted early and associated with proper drainage. From recent laboratory work with streptomycin it appears as if this drug may in the future play an important therapeutic role.

Owing to the insidious course, many patients will seek medical aid only after extensive damage has already occurred. Surgeons, therefore, will play an important role in forestalling complications in spite of chemotherapy. Culture of material from the myringotomy knife is also a decisive factor in deciding what therapy to apply.

Penicillin, although reported to be ineffective against Friedländer's bacillus in C. S. Keefer's recent compilation and others,[42] was administered in this case to aid against secondary invaders and with the hope that some actual antibacterial action against the bacillus itself might be observed. The fact that a synergic action between penicillin and sulfonamide compounds has been exhibited against certain organisms was not overlooked. Unger [43] has shown that the presence of para-aminobenzoic acid has increased the activity of penicillin against some organisms, and when sulfapyridine and penicillin were given together, the results showed increased protective effect of both drugs. This may be due either to the synergic activity of the two substances on the organism or, less probable, to a chemical reaction between the drugs. The bacillus isolated from our case was resistant to penicillin, according to sensitivity tests carried out by Miss Johnson. In all, no harm in the administration of penicillin was likely.

Streptomycin, found to be very active toward the strain from our patient, was not administered, because the patient responded so well to the other therapeutic measures.

Diabetes offered no problem, and the blood sugar was controlled by the usual methods.

Rothschild [26] expressed the belief that the physical properties of the spinal fluid may cause the grave prognosis. Mucus tends to fill in spaces and foramens, causing cerebral block, and may well be responsible for the generally fatal outcome. Zange,[25] in 1912, expressed the belief that the high spinal fluid pressures recorded in cases of Friedländer's bacillus

42. Hobby and others.[38] Abraham and others.[39]

43. Ungar, J.: Synergistic Effect of Para-Aminobenzoic Acid and Sulphapyridine on Penicillin, Nature, London **152**:245-246, 1943.

meningitis were due to mucoid growth in the spinal fluid which in turn hampered the circulation.

No one therapeutic factor can alone be held responsible for the recovery in the case presented. The combination of early operation and institution of treatment with sulfadiazine and penicillin, with good diabetic control, resulted in a cure. A long follow-up is certainly advisable.

SUMMARY

Fourteen cases of otogenous Friedländer's bacillus meningitis are presented, collected from all the available literature; 2 of the patients recovered, one being our own. In all cases the picture was similar.

Friedländer's bacillus is a gram-negative rod which grows on simple mediums. The strains have been classified into four immunologic groups. Because of the fermentative variability of the strains, classification on such a basis is of little value.

Friedländer's organism is immunologically related to Pneumococcus II and the bacillus of rhinoscleroma and is often confused with the B. coli–B. aerogenes group. It is a pathogen associated with extensive suppurations of the body. A relationship appears to exist between infections with Friedländer's bacillus and diabetes mellitus.

Friedländer's bacillus as a cause of otitis media is rare, and the clinical and pathologic picture is very similar to that of typical Pneumococcus III otitis. Complications are frequent. Of these, otogenous meningitis is one of the most common.

No dependable therapeutic measure has been found. However, some assuring results have been noted with sulfadiazine. Streptomycin may prove effective against this organism in the future. In view of the usually insidious course an early extensive mastoidectomy seems to be the most important therapeutic feature.

Drs. Louie Royer and Jules Waltner gave assistance in the transcription of foreign literature. Miss Balbina Johnson and Miss Helen Erhorn aided in the bacteriologic phases of this study.

CLASSIC AND OTHER TYPES OF TRACHEOTOMY

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GRAND JUNCTION, COLO.

TRACHEOTOMY is one of the most important operations known, because it is lifesaving to the highest degree and, furthermore, is performed for various other indications. Its mastery is therefore an urgent requirement for every physician, but above all necessary for the rhinolaryngologist, who on frequent occasions may suddenly be called on to perform it.

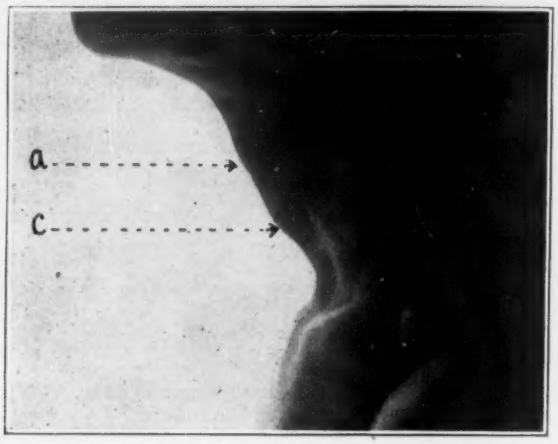

Fig. 1.—Orientation. In a side view of the neck two prominences can be seen (and palpated): The upper one (*a*) is Adam's apple of the thyroid cartilage; the lower one (*c*) is the ring of the cricoid cartilage. The latter is the lowest point of resistance in the anterior surface of the neck and the fundamental point of orientation in every type of tracheotomy.

The performance of tracheotomy requires a certain amount of knowledge of the anterior region of the neck. I want to present that to you very simply.

Look at the neck from the side (fig. 1) or, even better, palpate your own neck in front, bending the head slightly backward and stroking with your finger gently from above downward along the anterior surface of the neck in the middle line. You feel two main prominences, one above, one below. The upper one is Adam's apple; the lower one is the important

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one for present purposes. Your finger slips below the lower one into soft tissue and loses the feeling of resistance. It is the lowest prominence on the neck. Moving your finger upward from the soft tissue, you feel it again. You cannot miss it. Forget about all other prominences and remember only this lowest one. This last resistance is the ring of the cricoid cartilage. It is the fundamental point of orientation in every type of tracheotomy. Every physician should practice this simple localization of the cricoid cartilage on every occasion. It indicates the beginning of the trachea and informs one of the location of the trachea at the start and in every stage of the operation no matter how fast one has to do it or how bloody the operative field.

Besides, this prominence gives one information of the most superficial section of the trachea, for below the cricoid cartilage the trachea deviates backward and lies farther away from the surface the farther it descends from the ring cartilage.

I shall give you a few more anatomic details later as they are needed during the operation.

One differentiates betweeen the regular tracheotomy and the emergency operation.

THE EMERGENCY TYPE

I should like to discuss here first the emergency operation.

It is the operation of which you have heard occasionally that it has been performed somewhere (in a restaurant or on the street) with a pocket knife, and, in fact, every practitioner should be able to do it this way if necessary. It is one of the most dramatic and brilliant surgical interventions.

How is it performed? Again the cricoid cartilage is one's orientation. Palpate it on yourself again, feel the prominent step. But this time move slowly back upward, and right above the step you will feel a little groove into which the tip of your finger sinks, a groove which is limited by a resistance above and below. Above is the thyroid cartilage, below is the cricoid cartilage, and the groove represents the cricothyroid ligament between them.

This is the place. It is free of cartilage and is membranous only. The place known, the operation is simple and can be performed in a few seconds. Anesthesia is mostly unnecessary. With the head of the patient deflected back, you fix his larynx with the middle finger and thumb of your left hand; the left index finger is your guide, and your right hand stabs the knife in transverse direction, near to the cricoid cartilage, about 1 cm. deep through the skin and ligament or one after the other. The incision should be transverse for three reasons: (*a*) to avoid the small anastomosis of the cricothyroid arteries which run in transverse direction and which you will miss if the incision is made parallel to it and nearer

to the cricoid than to the thyroid cartilage, (*b*) to avoid injuries to the cartilage above and below the ligament, which would occur if the knife is held vertically, and (*c*) to make the incision gaping. The elastic fibers of the ligament gape wide open if they are cut transversely.

Of course, this is not a tracheotomy, but it accomplishes the same purpose: It opens the air passages below the obstruction and the patient is breathing again, safe from suffocation.

What now? Keep the wound apart with whatever is at hand (rubber tube, tooth pick, hairpin), and when the acute danger of suffocation is eliminated, take the patient to the hospital and perform tracheotomy. It is absolutely correct to do the stabbing of the cricothyroid ligament as an emergency operation in severe cases of asphyxia, but it is absolutely wrong to use it as a permanent form of tracheotomy.

Why? Because the cannula which you introduce into this opening between the two cartilages will exert continuous pressure on them. The cricoid cartilage is the most sensitive of all the laryngeal cartilages and will respond with chronic perichondritis, as a result of which thickening of the cartilage and secondary stenosis develop which make it difficult or impossible to remove the cannula later.

You have, under all circumstances, to perform now tracheotomy away from the cricoid cartilage if the obstruction of breathing continues. The incision in the cricothyroid ligament is harmless, and it will heal and take care of itself without any treatment.

THE REGULAR TRACHEOTOMY

When there is sufficient time for normal surgical dissection of the structures overlying the trachea, the regular tracheotomy is the operation to be performed.

The anesthesia for the regular tracheotomy is general for children, local for adults. A little codeine or morphine given previously is beneficial.

For the local anesthesia, 1 per cent procaine hydrochloride is used with addition of 1 drop of 1:1,000 epinephrine to each 5 cc. of that solution. The operative field is surrounded subcutaneously by a rhomboid figure (fig. 2). The acute angles of the rhombus are below in the jugular notch and above at Adam's apple; the obtuse angles are at the anterior margins of the sternocleidomastoid muscles at the level of the cricoid cartilage. These points are connected by subcutaneous lines of injection. This accomplishes complete anesthesia of all tissues inside the rhombus down to the trachea without disturbing the anatomic landmarks. Infiltration of the median line of incision is unnecessary and even disturbing, because it effaces the landmarks of the tissue layers and renders the anatomic orientation more difficult.

For the regular tracheotomy, the larynx is grasped between the middle finger and the thumb of the operator's left hand (if he is left handed, he grasps with the right hand) and after quick orientation by location of the cricoid cartilage with the index finger—as mentioned before— an incision is made through the skin and subcutaneous fat exactly in the middle line. The incision extends from a little below Adam's apple down to a little above the jugular notch. If the patient is a small child or a patient with a short, thick neck, or if the operator is not quite sure of his technic, the incision may reach from the hyoid bone to the jugular notch, which makes the orientation easier. Small retractors with blunt teeth are inserted and the wound spread (fig. 3*A*). Superficial veins are grasped with hemostats or simply compressed temporarily with a

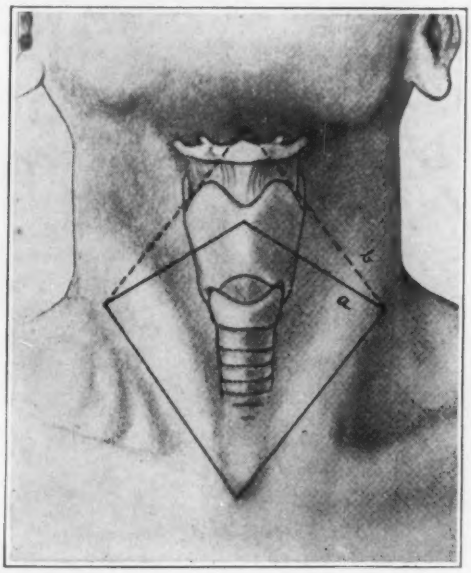

Fig. 2.—Local anesthesia. The subcutaneous lines of injection surround the operative field in a rhomboid figure: (*a*) for the regular tracheotomy; (*b*) for the emergency operation (if anesthesia should be necessary) and for laryngeal operations.

gauze sponge, put under the skin retractor. Cutting exactly in the median line, you may forget all about the complicated anatomic details on both sides of it. Remember only that there is a fascia connecting the muscles in the median line called linea alba, the white line (fig. 3*A*). The linea alba is split lengthwise exactly in the median line—if preferred, on a groove director. This avoids injuries of the isthmus of the thyroid gland which now comes in view (fig. 3*B*).

Tracheotomy may be a simple operation, and then again it may be a difficult operation. What makes the difference? The thyroid gland and how you handle it.

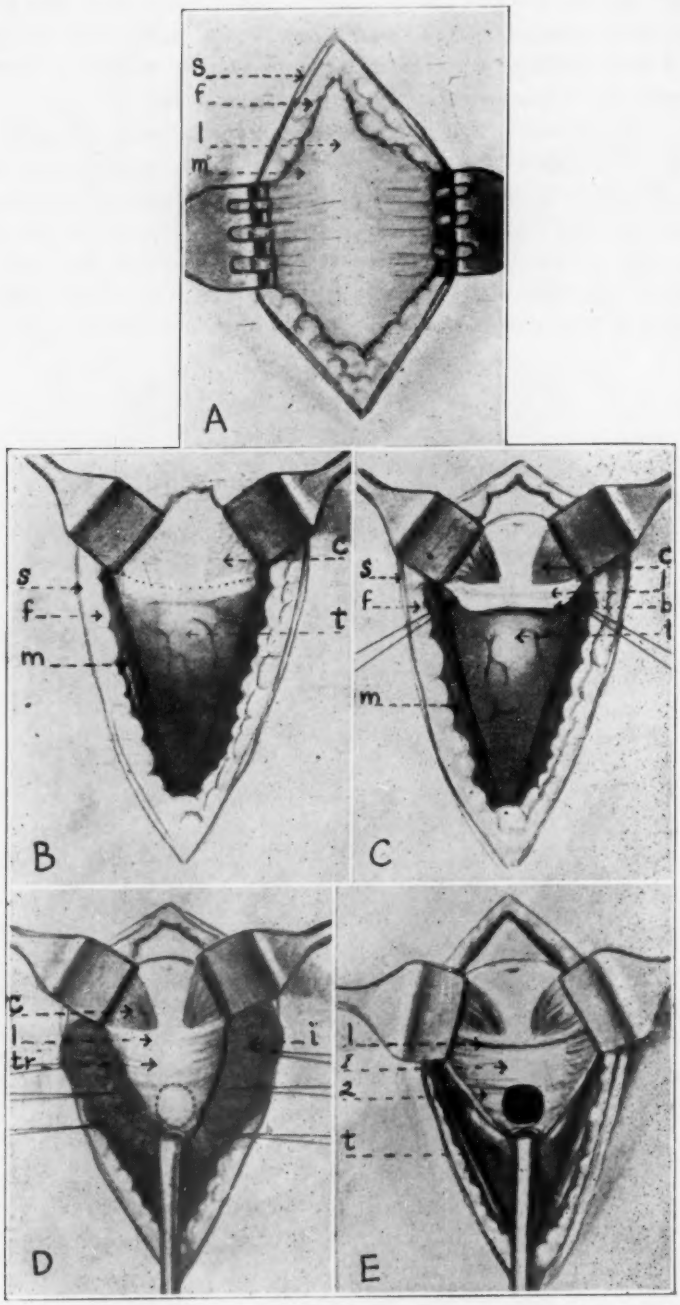

Figure 3

(See legend on opposite page)

Many surgical books—old and new ones—divide the tracheotomies into superior, inferior and medium ones, depending on the thyroid isthmus and whether you enter the trachea above it, below it or through it. I advise you to forget these subdivisions and remember only that the trachea has to be opened between the second and the fourth ring of the trachea. The shortest way to get there is the best one. It is quite natural that in children, in whom the thyroid gland lies higher, this way may be below the isthmus; in adults it is mostly above the isthmus. Neither should be a problem to you. It was Chevalier Jackson [1] in this country, Hajek [2] in the old country, whose teaching contributed greatly to spread the knowledge of these facts.

You know, now, the trachea should be opened between the second and the fourth ring. A quick move with your left index finger inside the wound toward the often mentioned cricoid prominence assures you

1. Jackson, C.: High Tracheotomy and Other Errors the Chief Causes of Chronic Laryngeal Stenosis, Surg., Gynec. & Obst. **32**:392 (May) 1921. Jackson, C., and Jackson, C. L.: Diseases and Injuries of the Larynx, New York, The Macmillan Company, 1942.

2. Hajek, M.: Pathologie und Therapie der Erkrankungen des Kehlkopfes, der Luftröhre und der Bronchien, Leipzig, Curt Kabitzsch, 1932.

EXPLANATION OF FIGURE 3

The regular tracheotomy is illustrated, step by step: *A*. A median incision is made through the skin (*s*) and subcutaneous fat (*f*). The sternohyoid muscles (*m*) become visible through the cervical fascia, and between them the linea alba (*l*).

B. The linea alba has been split lengthwise, and the muscles on either side (*m*), along with the skin (*s*) and the subcutaneous fat (*f*), are spread with retractors. The cricoid cartilage becomes visible, easily recognized by its winglike pair of cricothyroid muscles (*c*) showing through the fascia and by its prominent lower margin (dotted line). Below it, covering the beginning of the trachea, is the isthmus of the thyroid gland (*t*) covered by a fascia in front.

C. The layer of fascia covering the thyroid isthmus (*t*) anteriorly has been split transversely (*b*, Bose's incision) below the lower margin of the cricoid cartilage (*l*). This allows one to separate the isthmus from the trachea in blunt dissection. Other abbreviations are: (*s*) skin, (*f*) subcutaneous fat, (*m*) sternohyoid muscle and (*c*) cricothyroid muscle.

D. The isthmus of the thyroid gland when separated from the trachea may—if necessary for the exposure of the tracheal rings as sometimes in cases of enlargement of the thyroid gland—be split in the median line as far down as desired. Hemostats grasp it at each side of the median line, and ligatures are then applied as in tying blood vessels. In most of the cases, however, this is not necessary, and the isthmus may be displaced downward without median splitting, as in *E*. The abbreviations indicate: (*t*) isthmus, (*c*) cricothyroid muscle, (*l*) lower margin of the cricoid cartilage and (*tr*) first tracheal ring. The dotted line indicates the site of the prospective opening of the anterior tracheal wall.

E. Regular tracheotomy, concluded. The isthmus of the thyroid gland (*t*) after its separation from the trachea has been pulled downward by blunt retractor, and a window the size of the lumen of the cannula to be introduced has been excised from the anterior wall of the trachea at the level of the second and third rings. The abbreviations indicate: (*l*) lower margin of the cricoid cartilage, (*1*) first ring, (*2*) second ring of the trachea.

of its position. This prominence is much more easily palpable now than before through the skin. Besides, your eyes, too, will now recognize the cricoid cartilage: The pair of winglike cricothyroid muscles diverging upward and laterally (fig. 3*B* and *C*) distinguishes it from all other cartilages. This is the beginning of the trachea. The same index finger feels the rings of the trachea below it. But just the area necessary for the opening, namely, that between the second and the fourth ring, cannot be seen; it is covered by the isthmus of the thyroid gland, injury of which makes a tracheotomy more difficult. Bose,[3] in 1872, showed how to overcome this difficulty.

The isthmus of the thyroid gland is covered by a fascia in front and a fascia behind. Both fasciae join above and below the isthmus in a common layer which is fastened above to the cricoid cartilage (fig. 4). Splitting this common fascia right below the cricoid cartilage transversely —Bose's incision (fig. 3*C*)—leads you into a pocket behind and outside the isthmus, and in blunt dissection with the handle of your knife or blunt scissors you are able to separate the isthmus, bloodlessly, from the trachea and to pull it down with a retractor to expose the desired second and lower rings. You may enlarge Bose's incision to both sides with a snip of the scissors if necessary to mobilize a large isthmus better; if it is too large to be mobilized, grasp it with two hemostats, one at each side of the median line, and split it between them as far down as necessary to expose the second to fourth rings of the trachea (fig. 3*D*). Ligatures may be done now or left to the end of the operation. A retractor with one or two sharp teeth inserted below the lower edge of the cricoid cartilage and pulling the trachea slightly upward will assist in bringing these cartilages into view. (If the isthmus is high, as it sometimes is in small children, the same procedure—splitting the common fascia—can be followed below the isthmus and the isthmus bloodlessly separated and pulled upward to expose the second to fourth tracheal rings.)

Now the trachea is exposed, and you may take it easy. You can open the trachea at any time. Do it carefully and with deliberation. If you cut in and push the cannula in, the patient will have a terrible cough reflex, all vessels will start bleeding, he will cough up blood and secretion to the ceiling, finally the cannula, he will start choking, you will not find the opening—in short, there will be quite a mess on the operating table. I still remember the time when opening of the trachea was a serious matter.

To avoid all this, there is a very simple way introduced by St. Clair Thomson. One injects a few drops of 5 per cent cocaine hydrochloride into the trachea between two rings through a fine needle. You must

3. Bose, H.: The Technique of Tracheotomy, Arch. f. klin. Chir. **14**:137, 1872.

be sure the point of the needle is inside the trachea. Proof that it is, is the feeling of the needle getting into a cavity and a slight cough of the patient which at the same time sprays the cocaine solution around and anesthetizes the mucous membrane of the trachea. If you wait now a few minutes—which you may use for ligation of the vessels—you can open the trachea without any discomfort to the patient whatsoever.

To open the trachea, the so-called "classic method" has been practiced for over a hundred years. This is the method: After exposure of the trachea below the cricoid cartilage, the sharp retractor inserted into the lower margin of the cricoid cartilage is pulled upward by the operator's left hand. With a sharp-pointed knife the anterior tracheal wall is pierced

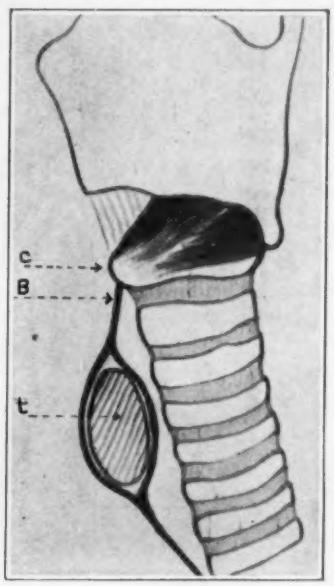

Fig. 4.—Diagram of the fasciae covering the isthmus of the thyroid gland (*t*). One layer of fascia covers it in front, one behind; both join above and are fastened to the cricoid cartilage (*c*). An incision here right below the cricoid cartilage (*B*, Bose's incision) leads extracapsularly, without injuring the thyroid gland, into a pocket between the thyroid gland and the trachea and can be widened in blunt dissection exposing the desired second and third rings of the trachea.

vertically, and then exactly in the middle line, two or three rings and the intercartilaginous ligaments are split. While the point of the knife is still inside the trachea, the assistant inserts two one-tooth retractors into the opening to both sides of the knife and grasps the edges of the split tracheal wall. Then he pulls them apart until the slit is sufficiently dilated for the introduction of the cannula. Exact managing of the retractors is especially emphasized. For spreading the incision, a dilator after Langenbeck or Trousseau may also be used. While the incision is spread, the cannula is introduced and the retractors (or the dilator) are then

removed. For changing dressings the same instruments are used; retractors (or a dilator) hold the incision apart and create room for the cannula.

This technic is still presented in many surgical and laryngologic textbooks. The principal objections to this split incision method are:

(*a*) The cut edges of the cartilaginous tracheal rings are spread apart, bent on themselves and buckled in an unnatural position in order to furnish room for the cannula. The section of the tracheal wall above the cannula is pushed inward, the section below it bent outward, by the curve of the cannula (fig. 5 *A*). If this condition becomes permanent, it results in a narrowing of the tracheal lumen from the front.

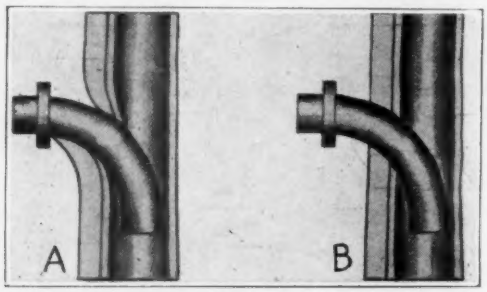

Fig. 5.—Opening of the anterior tracheal wall: *A*, split incision method; *B*, excision method. After the cannula has been introduced in *A*, the anterior tracheal wall above and below the cannula is dislocated. In *B* the wall is in its normal position.

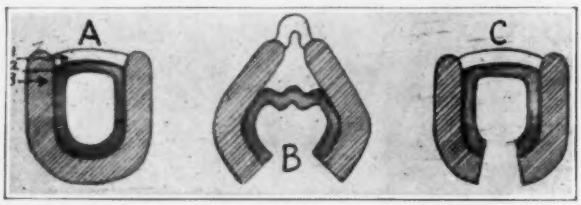

Fig. 6.—Diagrams of a cross section of the trachea. *A*, trachea before opening: *1* membranous posterior tracheal wall; *2* mucous membrane; *3* cartilage.

B and *C*, trachea after opening and introducing cannula: *B*, split incision method; *C*, excision method. In *B* the posterior ends of the cartilage are forced to approach, bulging the mucous membrane forward into the lumen of the trachea, narrowing it. In *C* all these parts of the trachea are in their normal natural position.

(*b*) The cartilaginous rings are C shaped, open at the back and connected there only by the membranous wall of the trachea (fig. 6*A*). Split in front in the middle and pushed apart and dislocated to the side by the cannula, the posterior ends are forced to approach behind, bulging the mucous membrane forward into the lumen of the trachea, narrowing it from behind (fig. 6*B*). This occurs especially in children in whom the posterior ends are somewhat bent inward by nature (Carrié,[4] fig. 7).

(Footnote on next page)

(*c*) The cut edges of the split cartilaginous rings, on which the cannula is continually rubbing, undergo inflammatory changes and become covered with granulations. The cartilage around the cannula becomes soft, is more or less extensively destroyed and is later replaced by connective and scar tisue, the shrinking of which contributes to the formation of a secondary stenosis. Even if no stenosis results, the trachea loses its cartilaginous support around the cannula, and after removal of the latter this part of the tracheal wall will move in and out with each inspiration and expiration.

If the cannula is removed immediately or at least after a short time (four to five days at the most), all these changes may subside and a complete return to the normal position may take place. But if the cannula, as happens in difficult decannulation, has to be retained for a long time, the dislocated cartilages become fixed in the wrong position, and granulation and scar tissue develop around the cannula as mentioned, with many evil consequences.

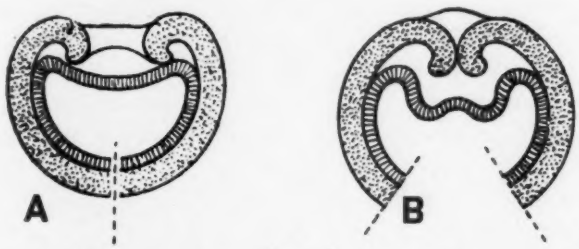

Fig. 7 (After Carrié [4]).—Cross section of the trachea of the child. The posterior ends of the cartilage are bent inward. *A*, shows the appearance before incision; *B*, that after split incision; the mucous membrane of the posterior wall is bulged forward into the lumen by the approaching and bent posterior ends of the cartilage, even more than in figure 6.

In addition, there are minor difficulties in this method when the cannula is changed. The slit in the trachea lies at the bottom of a long wound and is accessible only with difficulty. An assistant has to hold the edges of the tracheal incision apart or a dilator must be introduced every time, and often the change of the cannula becomes an upsetting experience for both the doctor and the patient.

All these ill effects caused by the pressure of the cannula on the tracheal wall can be eliminated if the incision into the trachea is done in a manner which makes room for the cannula without spreading and dislocating the cartilages. That means: An opening which corresponds to the size of the cannula has to be cut into the tracheal wall; instead of a

4. Carrié, L.: Contributions a l'étude des causes empêchant l' ablation definitive de la canule après la trachéotomie chez les enfants; varieté de retrécissement trachéal; bourgeons charnus de la plaie, Thesis, Paris, no. 13, 1879.

simple incision, an excision has to be made just as large as the cross section of the cannula which is to be used (fig. 3*E*). With such an excision present, there will not be any bending of the cartilages in front, no bulging behind, and no softening of the cartilages around the cannula (figs. 5*B* and 6*C*).

This principle—to make an excision—was used early,[5] and in England Marshall Hall and in Germany Dieffenbach were the fathers of this idea. Marshall Hall,[6] in 1848, used a cylinder of steel with a sharp lower edge, with which he cut out a round piece of the trachea after seizing the latter by a corkscrew-shaped tenaculum. Dieffenbach [7] removed a square piece of trachea amounting to two cartilaginous rings. American physicians, See and Donkoff,[8] at about the same time tried to avoid the consequences of the pressure of the cannula by cutting an opening into the anterior wall of the trachea and bracing it with a silver wire.

As barbaric as it looks at the first sight to sacrifice a healthy piece of tracheal wall, it proves in the end even more economical than the split incision which forcibly spreads the cartilages apart. One must realize that even after the simple, uncomplicated slit incision of the tracheal wall the tracheal cartilages never join again and that connective tissue is formed between them, which is like a callus and is of various size and extent. If the cannula cannot be removed soon in the split incision method, a much larger piece of the tracheal wall around the cannula loses its cartilage by inflammation and absorption because of pressure of the tube and is finally deprived of its cartilaginous support and moves in and out like a sail during every inspiration and expiration. Why not remove a small piece immediately, saving the rest from pressure and granulations and from more extensive destruction, and decrease the danger of secondary stenoses?

It is interesting to note that the excision method, though devised by leading surgeons of the time, has not been given much consideration by surgeons, but has been accepted and approved by laryngologists, above all by Thost,[9] of Hamburg, Germany, who made it the method of choice,

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5. Kuehn, J.: The Artificial Opening of the Upper Airways, in Guenther, G. B.: Operationslehre, Leipzig, C. F. Winter, 1864.

6. Hall, M.: Description of an Instrument for the Performance of Tracheotomy, Lancet **2**:283 and 530, 1848.

7. Dieffenbach, cited by Bardeleben, A.: Lehrbuch der Chirurgie und Operationslehre, ed. 6, Berlin, G. Reimer, 1872.

8. See and Donkoff, cited by Sorgnon, A.: Tubage ét trachéotomie en dehors, su croup chez l'enfant et chez l'adulte; manuel operatoire et complications; indications et résultats; parellèle entre ces deux méthodes, Paris, J. B. Baillière et fils, 1900.

9. Thost, A.: The Treatment of Laryngeal Stenoses in Children, München. med. Wchnschr., May 1892; Die Verengerungen der oberen Luftwege nach dem Luftröhrenschnitt und deren Behandlung, Wiesbaden, J. F. Bergmann, 1911.

and the Vienna School of Laryngology. That is perhaps no coincidence. The laryngologists are the ones who see and treat the patients in cases of difficult decannulation in which the cannula cannot be removed for months and years, and they have more occasion to study the consequences and damages of faulty procedures. (In fact this was Thost's lifework, and credit goes to him for the clarification of these conditions. The work is fundamental and still fully up to date. Many a modern method of treatment is in reality mainly a variation of the old Thost method without being an improvement on it.)

The idea of cutting out a portion of the tracheal wall rather than splitting it has a sound mechanical basis. No plumber working with metal or rubber tubing would consider making a union or inserting a connection through a split in a tube; he would cut a hole for the connection.

The use of a window incision in tracheotomy facilitates considerably the after-treatment and the change of cannulas. It makes assistance and dilators superfluous, and every change of dressing becomes a simple and safe procedure. As for the later fate of the window, it heals by membranous closure, and long years of experience have shown that it is harmless to the normal functioning of the trachea.

All I have said may be summarized in the form of two fundamental principles for a successful tracheotomy; they are as follows:

(*a*) The cricoid cartilage must not be injured under any circumstances; the trachea must be opened away from the cricoid cartilage at least as far as the second ring.

(*b*) The opening of the trachea has to be established in such a manner that room is furnished for the cannula without dislocating the tracheal rings. This means an excision has to be made.

The excision is customarily performed with forceps and small bent scissors and should be made as sharp edged as possible; the cartilage together with the tracheal mucous membrane should be cut out precisely and in just the right size to accommodate the cannula. This may be a little difficult, especially if there is ossification of the cartilages in older people. To facilitate the procedure and to insure the right size, I have devised an instrument which automatically makes the opening of proper size, clean and sharp edged, regardless of the hardness of the cartilage and, in addition, prevents the excised piece of tracheal wall from being aspirated into the bronchi.[10] It has proved satisfactory in many tracheotomies and has been adapted to fit the universal handle (fig. 8).

The resection is performed simply in the following way: After exposure of the trachea, the membranous ligament between the second and

10. Waldapfel, R.: The Opening of the Anterior Wall in Tracheotomy, Surg., Gynec. & Obst. **71**:191 (Aug.) 1940.

the third tracheal ring is split transversely with a small knife. The disk of the instrument is introduced into the slit, and the instrument is closed like a conductor's punch. It is removed, and the excised piece of trachea is contained therein. The entire procedure could not be simpler. By the opening thus produced, the cannula is passed easily into the trachea without any retractors or dilator being necessary.

After the trachea is opened, there follows a stage of apnea, which appears threatening to the inexperienced. The patient seems to quit breathing. It is similar to the condition of the newborn right after birth. The breathing center irritated before continuously by an overload of carbon dioxide in the blood does not get impulses enough now when the oxygen is pouring in. After a short while, the patient starts breathing again.

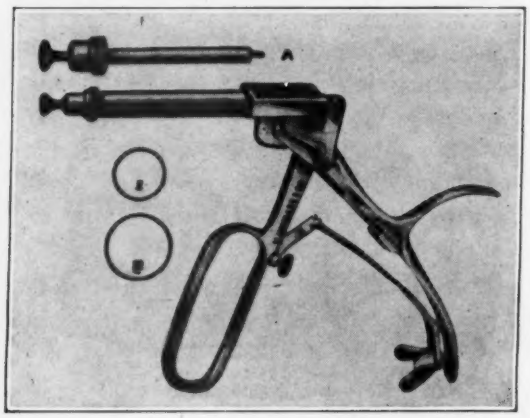

Fig. 8.—A tracheal punch for excising the window in the anterior tracheal wall, attached to a universal handle: *A*, is one of the exchangeable parts for openings of various sizes. *1* is a smaller opening, *2* a larger opening, excised with the instrument.

The wound is shortened by one suture above the cannula. The more open the wound the less danger of infection and of air entering the tissue spaces. Into the lower end of the wound below the cannula, a strip of iodoform gauze may be loosely packed. It protects the isthmus of the thyroid gland from pressure of the cannula.

The cannula is held in place by a tape which is threaded through the two side eyes of the shield of the cannula and tied at the back of the neck of the patient. Rule 1: Until this tape is tied, the operator or the assistant has to hold the cannula in place by keeping a finger on its shield from the first moment the cannula is introduced so that it cannot be coughed out. Rule 2: The tape has to be tied firmly with a real knot (not a bowknot). A loose cannula irritates the patient and is much more liable to slip out of the trachea. A piece of gauze has to be put between the

knot and the skin to prevent pressure sores—especially in old people—which may cause more discomfort to the patient than the wound.

Dressing and covering of the wound are best done with a square piece of gauze (3 by 3) cut in one side and placed astride the cannula. This "rider" covers the wound nicely, leaving sufficient room for the cannula and can even be changed without removal of the latter. No smaller sizes of gauze, which could be drawn inward, should be used. A few rounds of bandage around the neck conclude the dressing. Below the shield of the cannula one puts a piece of oil silk sheeting and ties it with two strings loosely around the neck over the bandage. It keeps the skin clean and free from expectorated tracheal secretion.

A few words about cannulas. This was formerly a very complicated chapter. It has been considerably simplified in this country by the Jackson cannula, which takes sufficient care of the sizes and lengths and does away with all clumsy details of the shield. In Europe it is Luer's cannula which is most widely used. Both are similar as to their curve, which is a segment of a circle. In England the Durham cannula is frequently used, which is more rectangularly bent and slightly more difficult to introduce.

All these modern cannulas consist of two tubes, an inner one and an outer one which allow cleaning of the cannula by cleaning of the inner tube alone without the whole dressing being changed. They all should have a "pilot" which facilitates the introduction considerably.

AFTER-CARE

The after-care of the patient is as important as the operation itself. Tracheotomy requires more than usual postoperative attention of physician and nurses, and I know of numerous cases in which the patient was lost after a successful tracheotomy during the days following the operation.

The patient breathing through a cannula is deprived of the nose as an air conditioner; that means he lacks the mechanism which moistens and prepares the air in the upper air passages before it enters the trachea and bronchi. Microscopic studies [11] have shown that the ciliated epithelium of the trachea soon loses its cilia in people breathing through a cannula if care is not taken to compensate for the lack of moisture in the air. Moderate temperature (70 F.) and plenty of moisture are therefore essential for the atmosphere around the tracheotomized patient. Steam vaporizers and inhalation machines should be running continuously the first few days, and moist sheets should be hung over racks by the bed. For a child a tent of moist sheets should be made over the whole bed. No morphine, codeine or atropine should be given.

11. Grossmann, B., and Hofer, G.: Histopathology of the Trachea in Bearers of Cannulae, Monatschr. f. Ohrenh. **55**:1186, 1921.

The inner tube of the cannula has to be changed and cleaned with a pipe cleaner sufficiently often by the nurse. Remaining secretions are rinsed out with cold water before the cannula is boiled. Whenever a certain noise—which one soon learns to recognize by experience—indicates that the breathing is not quite free, breathing must be restored to normal. A tracheotomized patient should breathe as quietly as any other person. If cleaning of the inner tube does not accomplish it, the surgeon should be instantly notified, and he should change the outer tube.

Everything for changing the dressing should always be on hand, especially retractors, a dilator (fig. 9) and cannulas of various sizes and lengths, a duplicate of the cannula the patient is wearing, and, first of all, a good light. The surgeon discovers in most cases that there is a crust at the end of the outer tube or that the tube does not reach properly into the trachea. He takes care of either condition, and after normal breathing is restored, he turns the patient over again to the nurse. If the changing of the outer tube still does not produce normal breathing, tracheoscopy has to be done through the tracheal opening.

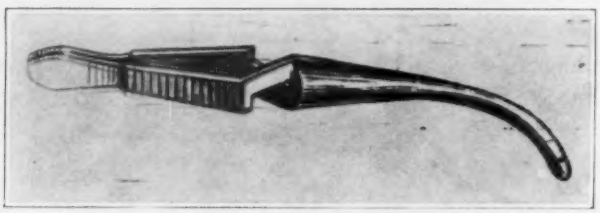

Fig. 9.—A tracheal dilator after Langenbeck. Its curved tip is introduced into the tracheal wound and into the opening of the anterior tracheal wall and then spread by compressing the handle from both sides.

Another point to be considered in the after-care, especially in the first hours following the operation, is the feeding of the patient. One does not know why, but somehow the swallowing mechanism may be altered by tracheotomy. Sometimes the patient who has swallowed normally before the operation has difficulties in swallowing the right way afterward; food particles get into his trachea. This may be harmless in a patient with a good cough reflex but dangerous in an older person in whom this reflex is faint. It is important that the operator watches the first feeding. He lets a patient swallow something colored—a bit of boiled black coffee or white milk—and has him cough for a while. It is quite surprising then how in some cases a patient who has not coughed before at all coughs all the coffee or milk out through the tube. If that is the case, the patient is fed the first day through a soft esophageal tube and continues to be fed in this way until the "coffee and milk test" reveals that no more food is passing into the trachea; the normal swallowing mechanism is usually restored in one to two days. Old surgical books

mention a disposition of the older person to get pneumonia after tracheotomy. I do not believe in this disposition and never have seen it although I have observed hundreds of patients who had undergone tracheotomy. The pneumonia is simply an aspiration pneumonia caused by food getting into the lungs, and can be avoided.

COMPLICATIONS

A few words about the most frequently encountered complications.

Hemorrhages.—If they occur after tracheotomy, they originate usually from some place in the isthmus. That is important to know, because the patient expectorates the blood through the cannula, and it always looks as if it had come out of the trachea. Packing between cannula and isthmus readily controls the hemorrhage.

Emphysema.—If the nurse calls you after the tracheotomy and reports that the patient is swollen, it is subcutaneous emphysema. The patient expectorates air under pressure, and the air enters the subcutaneous loose tissue. A swelling develops which when touched with the finger crackles like parchment. It occurs most often when the wound is too tightly closed. It is harmless if discovered in time. The sutures have to be opened and the wound to be packed with gauze. If this is not done, then, of course, it can spread far, even into the mediastinum, and become more serious.

Disturbances in Swallowing.—These have already been discussed.

DECANNULATION

When shall the cannula be removed? The question is easily answered: As soon as possible. The sooner it is done, the more certainly all damages will be avoided which develop when the cannula is retained over a longer period. Otherwise, the duration depends on the cause for which the tracheotomy is performed. After extraction of a foreign body for which tracheotomy became necessary, one can usually decannulate immediately; after diphtheria, usually at the end of a few days, sometimes weeks; in chronic obstructions, often only after years and long treatment. The old physicians had a test, especially after tracheotomy for diphtheria. The cannula was blocked and the patient asked to blow out a light. If he succeeded, the cannula was removed. I would recommend this rule: If the patient is able to sleep for two nights with the tube blocked, you may remove it. Sometimes a patient is able to breathe fairly well during the day, but as soon as he goes to sleep, he has difficulty in breathing.

Another important point is that he should be able to breathe also after the cannula is removed, since the cannula functions as a kind of dilator and sometimes eliminates existing stenoses. This suggests an important point in differential diagnosis between laryngeal and tracheal

stenosis after tracheotomy: If the patient cannot breathe with his cannula blocked, the obstruction is situated in the larynx. If he can breathe with his cannula blocked but not when the cannula is removed, the obstruction is situated in the trachea.

Thus the answer to the question as to when the cannula may be removed is: as soon as the patient can breathe day and night with the cannula blocked, as well as without the cannula. Strictest observation is essential during the first days after the removal, and of course the patient has to stay in the hospital during this time. If there is any doubt about a stenosis still existing, the decannulation has to be done gradually, the cannula being corked more and more, or smaller cannulas gradually introduced. Sometimes a child gets so used to his cannula that it cannot be removed without a spell of apparent dyspnea following. Such patients one must sometimes deceive by pretending to change the tube while putting it into the dressing in such a way that the patient cannot use it. Nevertheless, he will breathe excellently.

Two important rules have to be observed before the patient is sent home:

(*a*) If you send the patient home without a cannula, never do it without first checking the opening into the trachea for granulations. The best instrument for this purpose is a long nasal speculum or a large aural speculum. If you find granulations, cauterize them with a bead of silver nitrate or, if they are large, remove them with an ethmoid forceps.

(*b*) If you send the patient home with the cannula, as when he has chronic stenosis, never dismiss him without his being able to change his cannula himself. This will be the case when the original obstruction on account of which you have tracheotomized the patient cannot be eliminated or when, because of the tracheotomy, a secondary stenosis has developed which makes removal of the tube impossible.

The treatment of either condition belongs to the chapter on the handling of stenoses and is beyond the scope of this paper. As for the secondary stenoses, it is much easier to avoid them than to cure them. To show how they can be avoided by a properly performed tracheotomy is one of the main aims of this paper.

De Merschman Gardens.

Case Reports

TERTIARY SYPHILIS OF EAR, NOSE AND THROAT

LIEUTENANT ABRAHAM I. GOLDNER (MC), U.S.N.R.

UNDER the impact of concerted efforts to limit congenital syphilis and to treat acquired syphilis adequately, the aural and nasopharyngeal manifestations of this dread disease have been reduced to a minimum. Those which do appear are usually of minimal or transient involvement, and permanent deformity is rare. The usual after-effect of congenital syphilis is the typical saddle nose depression, and this condition is not as a rule accompanied by pharyngeal scarring or syphilitic otitis media. Tertiary lesions when recognized early and treated promptly usually subside with minimum scarring and destruction.

A case of neglected tertiary syphilis is presented because it demonstrates extensive involvement of the nose with almost complete destruction of its osseous and cartilaginous framework, marked scarring and distortion of the palatal and pharyngeal tissues and destructive otitis media.

Incidentally, the patient demonstrates the marked deterioration of public health practices under the Japanese occupation of the Philippines; for it is quite probable that if he had been treated early and adequately, the present condition would have been reduced to a minimum.

REPORT OF A CASE

J. G., a 45 year old Filipino laborer, was employed at the Submarine Base at Subic Bay, Luzon Island, in the Philippines. When he reported to the sick bay for treatment of a minor injury of a finger, the severe nasal deformity was noted, and it was decided to investigate it further because of its obvious clinical interest.

He stated that about four years before this pain and swelling of his nose developed. He received a few injections of some unknown material. He was unable to give any further information. In any event, at the time of inquiry he had no symptoms referable to the ear, nose or throat. He was married and had four children living and well.

Otolaryngologic Examination.—Examination of the ear, nose and throat revealed the conditions shown in figures 1 and 2.

The external nose was completely absent except for a triangular rim of external nares. The nasal septum was completely destroyed; the lateral walls impinged on each other, leaving a narrow, tortuous passage, through which it was difficult

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to pass even a narrow probe. The structure of the turbinates was also completely destroyed. The mucosa was pale and thickened; there were no ulcerations.

The mouth revealed poor dentition. The soft palate was absent, and the hard palate showed the typical stellate scarring often described in textbooks and the literature. The anterior and posterior pillars were atrophic, scarred and distorted; the tonsils, small and fibrotic.

There was extensive scarring in the nasopharynx, and one fold of tissue divided it into two compartments, with a fistulous tract connecting them. Here, as externally, the findings were bizarre.

The vocal cords were normal in appearance, but the aryepiglottic folds were distorted and scarred. The epiglottis was thin and pointed but showed no ulceration or other destruction.

Both external ears were normal. Both tympanic membranes showed extensive multiple ragged perforations. There was a small amount of mucopurulent exudate

Fig. 1.—Deformity caused by tertiary syphilis.

present. Hearing for conversational voice was reduced to approximately 10 feet in each ear.

Laboratory Tests.—Unfortunately, there were no facilities for biopsy, but a Kahn test performed on Nov. 19, 1945 was reported as positive.

Differential Diagnosis.[1]—The main diseases to be differentiated are tuberculosis and lupus vulgaris. Such conditions as leprosy, yaws or rhinosporidiosis present grossly different patterns; so these should not present problems of differential diagnosis.

In tuberculosis, the involvement is not so extensive or so fulminating. The perforations are usually anterior, and the edges are thickened and covered with granulation tissue, whereas in syphilis the edges are sharp and clean, and there is a predilection for osseous tissue. Abscess formation is also more prone to

1. Lederer, F.: Diseases of Ear, Nose, and Throat, Philadelphia, F. A. Davis Company, 1938, pp. 343-356.

occur in tuberculosis, and this condition does not respond to potassium iodide or to arsenicals. In tuberculosis, frequently a primary site can be demonstrated, and a biopsy will reveal the typical features of tuberculous granuloma. The serologic tests would be negative.

Lupus is primarily a disease of the skin and mucous membranes; syphilis has a predilection for bone, while lupus attacks only cartilage. The course of syphilitic infection is more acute. In lupus the epiglottis is involved and destroyed.

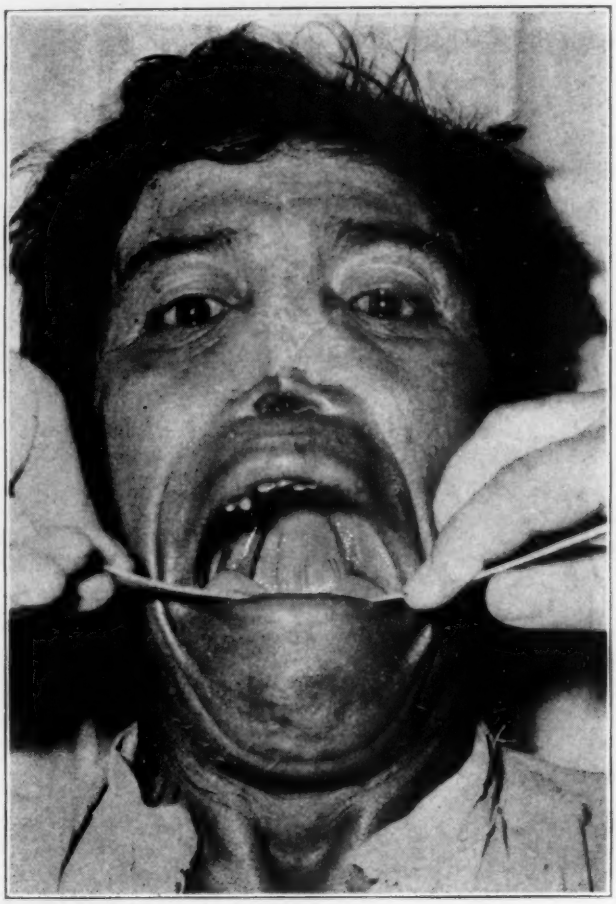

Fig. 2.—Appearance of pharynx involved in tertiary syphilis.

It is admitted that the diagnosis of syphilitic otitis media [2] in this case is presumptive. However, syphilis of the middle ear has been described. It is felt that in the tertiary forms infection occurs via implantation through the blood stream. The diagnosis is made by biopsy and rarely by the finding of spirochetes in the exudate by use of the Levaditi technic. In this case it is felt that the amount of

2. Fowler, E. P., Jr.: Medicine of the Ear, New York, Thos. Nelson & Sons, 1939, p. 184.

destruction in the middle ears was more than coincidental and together with the extensive involvement elsewhere justified the diagnosis of syphilitic otitis media.

Treatment.—Treatment was not rendered. However, the therapeutic procedures usually fall into local and specific groups. Locally, cleanliness, drainage of infection when necessary and plastic surgical correction of inactive deformity comprise the treatment of choice. Specifically, administration of large doses of iodides and the heavy metals, with cautious use of arsenicals, is indicated.

SUMMARY

An unusual case of advanced syphilis of the ears, nose and throat is presented.

The condition must be differentiated from tuberculosis and lupus, and several diagnostic features are given. Serologic tests, therapeutic use of iodides and biopsy are most important.

Treatment falls into specific treatment of syphilis and local measures such as cleansing and plastic surgical correction of deformity.

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RHINOSCLEROMA IN BRAZIL

With a Report of a Case

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BRAZIL has been mentioned as one of the South American countries which has a focus of rhinoscleroma. This is an erroneous deduction, since the survey has shown that only 25 cases had been recorded in Brazilian medical history prior to the report of the case presented here. Up to 1940 only 1 patient with rhinoscleroma was encountered among 16,000 patients examined in our clinics. A survey of all Brazilian literature and personal communications with directors and professors of large clinics definitely prove that Brazil cannot be considered as a country that has a focus of rhinoscleroma, particularly since only 16 of the 26 verified cases reported were autochthonous.

This small group of cases found in Brazil certainly does not compare with the incidence reported from Russia, where 1,500 cases were reported in 1932. Prof. Eduardo Morais, in discussing a report presented by Ermiro Lima and George da Silva at the Brazilian Otorhinological Congress in 1938, refuted their statement that the disease was endemic in Brazil, stating that he had never seen a single patient with rhinoscleroma in his large clinic at Bahia. The reason for this apparent inclusion of Brazil was due perhaps to a geographic error. There are two cities of Salvador, one is the capital of the state of Bahia of Brazil, while the other is the capital of the Republic of San Salvador, which is in Central America. It is in the latter city that a great many cases of rhinoscleroma have been found.

In this communication no attempt will be made to present a scientific research of rhinoscleroma in general, since the character of the disease in all its forms has been established; hence I shall proceed to discuss the following case:

REPORT OF CASE

A white Brazilian housewife, 23 years old, was seen on July 18, 1940 because of attacks of dysphonia which were becoming progressively worse and associated with attacks of dyspnea. More recently she complained of nasal obstruction, which subsequently advanced to the point of total obstruction. The family history is irrelevant. She has been married for eight years, has two children and has had no abortions. Both she and her husband are Brazilians and have descended from Brazilians. They have always lived in São Paulo or Minas, both states in Brazil. The only noteworthy incident of her past medical history was that of a burn of her left leg, which healed normally but was followed ten years later by a blister that was rather slow in healing and today presents all the macroscopic characteristics of a leishmanian cicatrix.

The rhinoscopic examination revealed that both nares were obstructed by many polypi apparently arising from the anterior ends of the inferior turbinates and from the septum (fig. 1). The middle turbinates showed only early, moderate

degeneration. The polypi appeared smooth and glistening and bled easily on being probed. Transillumination showed all sinuses to be clear. The rhinopharynx, the oropharynx and the hypopharynx were essentially normal. The tonsils were cryptic and chronically diseased. The larynx showed hypolaryngitis with polypoid formations decending into the trachea. These were covered by a crust and had an appearance similar to the polypi found in the nose. Otherwise the larnyx appeared normal. The cords were slightly reddened and congested. The ears were normal. There was no cervical adenopathy. In addition, one noted a marked fetid odor, which resembled the odor of ozena. The Wassermann reaction was slightly positive, but tests for tuberculosis and leishmaniasis gave negative results.

Fig. 1.—The patient in 1940, before treatment.

She was under antisyphilitic treatment, but intolerance of arsenicals had developed. A provisional diagnosis of leishmanian polypi of the nasal septum was made. Preoperative treatment was instituted, and she seemed to have responded fairly well to this treatment, with marked recession of many of the nasal growths. On August 7, approximately three weeks after her initial examination, all intranasal and subglottic growths were removed, with the patient under local anesthesia, without any untoward results. Smears were made, but it was not possible to detect any Leishman bodies. Five days later tonsillectomy and adenoidectomy were performed, with the patient under local anesthesia. In the meantime she was receiving fuadin, calcium chloride, a proprietary quinine bismuth iodide ("iodobisman") and an aromatic nasal antiseptic.

The histologic report was made by Prof. Moacir Amorim. The tissue was fixed in 10 per cent solution of formadehyde. There were five fragments of the tissue, of varying sizes, the largest 18 by 14 by 7 mm. The one was oval in shape with the flat surface on one side covered by a white opaque mucosa. The opposite surface was slightly rough, corresponding to the nasal wall in which it had been inserted. The tissue had a firm, compact texture and was more or less whitish throughout its greatest extent, with a few grayish red spots. The other specimens presented a similar appearance. For histologic examination six fragments were embedded in a paraffin block and stained with eosin-hematoxylin and with iron–hematoxylin–Van Geison stain. The sections showed a mucosa of a thin stratified epithelium. The whole corium and other portions of the tissue were made up of a peculiar type of granulation tissue, full of abundant round and oval cells with a light cytoplasm, which was strongly vacuolated. The nuclei were small, occasionally pyknotic, and either central or eccentric. These histiocytic elements occurred singly or in numerous groups, thus presenting the typical appearance of Milkulicz cells. Between these histiocytes there were a great many plasma cells, which were occasionally multinucleated, and often they surrounded the capillaries. In certain areas there were small clusters of neutrophilic granulocytes. Russell's hyaline corpuscles were seen either free or in the cytoplasm of the plasmocytes. There were no giant cells or any extensive areas of necrosis. The histologic diagnosis was rhinoscleroma.

The photomicrographs in figures 2 and 3 illustrate the histologic report. Rather surprised at this report, I submitted a section to another laboratory for interpretation. Furthermore, bacteriologic studies were made of the secretion of the nasal mucosa. From this secretion the Frisch bacillus was isolated. Although Babés, Perkins and Simon have disagreed, most investigators have expressed the opinion that Bacillus rhinoscleromatis is pathognomonic of this disease. This organism may be a strain of Bacillus mucosus capsulatus, but it has many significant cultural characteristics, especially when grown in a medium of horse serum with 5 per cent glycerin. Here, it presented a colonization that resembled drops of stearin, and this according to Vaccara is characteristic of the Frisch bacillus.

In spite of the marked improvement of the rhinologic appearance, as well as of the general state of health, a continuance of the internal administration of fuadin was insisted on. Improvement continued, and there was progressive regression of the tracheolaryngeal hypertrophies. Consequently, I decided against any further surgical treatment. The patient was discharged from the hospital and continued under observation until October 3; at that time she appeared to be completely cured. She subsequently left town. In order that the observations made might be verified, she was traced four years later, at which time she was found to have a perfectly normal-appearing nose without evidence of recurrences. However, in the course of a recent infection of the upper respiratory tract she had become hoarse. The larynx showed a small mass of sclerotomatous tumor in the anterior subglottic region, which was definitely isolated and did not interfere with or involve the rest of the larynx. The vocal cords were also slightly irritated. The pharynx was normal in appearance and in view of the absence of any other significant changes I again prescribed fuadin or stibine in case fuadin was not available.

Bearing in mind the fact that a single case does not constitute a real basis for discussion, I shall nevertheless attempt to draw a few conclusions from this case.

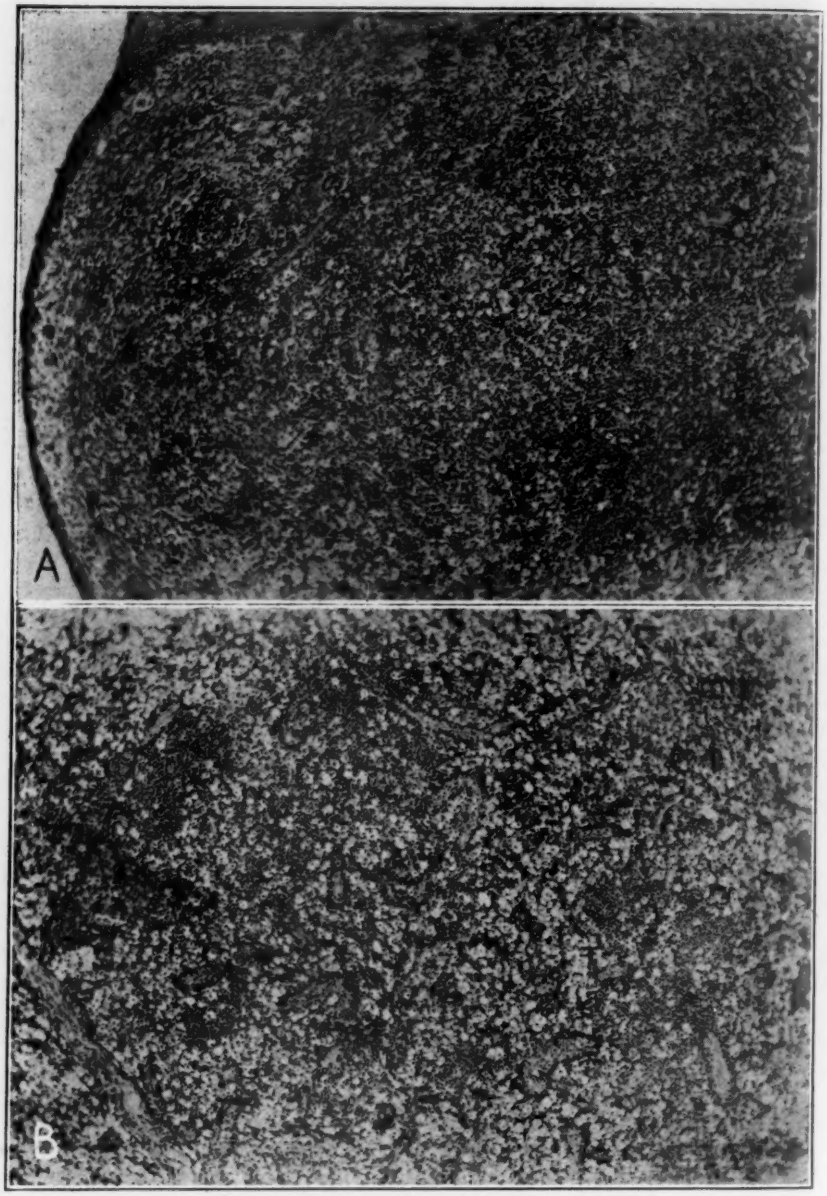

Fig. 2.—*A*, photomicrograph of a section of the tumor under low magnification. *B*, same section under high magnification.

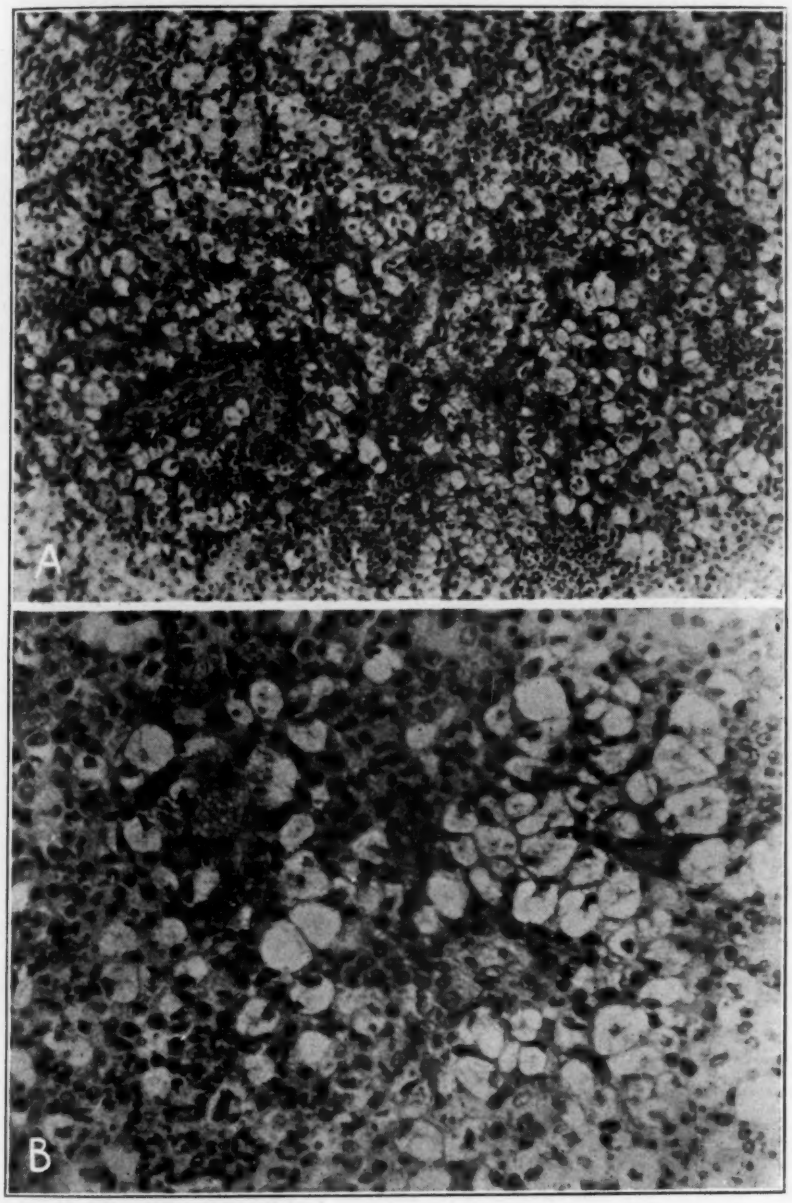

Fig. 3.—*A*, photomicrograph showing Mikulicz cell and Russell corpuscles. *B*, another characteristic aspect of the rhinoscleromatous lesion under high magnification.

The verified diagnosis of rhinoscleroma makes this the twenty-sixth case which has been reported in Brazil. The accompanying table gives a summary of all cases of rhinoscleroma reported in Brazil. From this it may be seen that the occurrence is more frequent among the Negro than among the white people and that women are somewhat more susceptible than men.

It is observed that the disease presents in its incipiency many rhinolaryngotracheal manifestations. This is a common occurrence, accord-

Cases of Rhinoscleroma Known and Studied in Brazil

Case*	Author	Date of Publication	Race	Sex	Place of Birth	Comment
1	Adolfo Lutz	1890	.....	..	.....	First national observation
2	Ataliba Florence	1909	Negro	F	Brazil	
3	Ataliba Florence	1909	Negro	F	Brazil	J. Marinho (?)
4	Fernando Terra	1921	White	..	Europe	J. Marinho
5	Fernando Terra	1921	Negro	F	Brazil	J. Marinho
6	Fernando Terra and Werneck Machado	1921	White	F	Brazil	J. Marinho
7	Fernando Terra and Werneck Machado	1921	Negro	M	Brazil	J. Marinho
8	Areia Leao and Rego Lopes	1924	.....	..	.....	
9	Paulo Parreiras Horta	....	.....	..	.....	Through Prof. Sanson's information
10	Castro, Gomes and Ottoni de Rezende	1926	Negro	M	Brazil	
11	P. Castro Mendes	1924	White	F	Europe	
12	Renato Machado	1922	Negro	M	Africa	The patient was 118 years old
13	Ildeu Duarte	1923	White	M	Brazil	
14	Ildeu Duarte	1923	White	F	Brazil	
15	Rezende Barbosa (Mario Ottoni)	1938	White	F	Brazil	
16	Ermiro Lima and George Silva	1938	White	M	Europe	
17	Aristides Monteiro	1940	White	F	Europe	Not yet published
18	Aristides Monteiro	1940	Negro	M	Brazil	Not yet published
19	Aristides Monteiro	1940	Negro	F	Brazil	Not yet published
20	Getulio Silva and Cap. Per.	1941	Negro	M	Brazil	
21	George Silva	1941	Negro	F	Brazil	
22	Aristides Monteiro	1944	Negro	M	Brazil	Not yet published
23	Mario Ottoni and Rezende Barbosa	1944	Negro	M	Brazil	Not yet published
24	Mario Ottoni and Rezende Barbosa	1944	White	M	Brazil	Not yet published
25	Mario Ottoni and Rezende Barbosa	1944	White	M	Europe	Sclerosis of external auditory canals only
26	Pedro Falcão	1944	White	F	Brazil	Observed in 1940

* There is a certain confusion about the first 9 cases in the Brazilian statistics, due to the fact that the same patients have been referred to in different papers.

ing to Chiari. In consequence, Botey [1] proposed to substitute the term "scleroma" for "rhinoscleroma." In Brazil Marinho [2] called attention to the fact that in the Negroes the disease is usually in the nasal cavity and its surroundings. The latter observation was also substantiated by

1. Botey, R.: Tratado de otorrinolaringologia, Barcelona, Salvat Editores S. A., 1925, p. 292.

2. Marinho, J.: Rhinoscleroma nos pretos, Bol. Soc. de med. e cir. de São Paulo, 1926, p. 293.

Szmurlo,[3] who stated that in 75 to 80 per cent of instances scleroma is localized principally in the nose; it develops in the anterior portion of the septum or on the surface of the nose in the form of a more or less subepithelial infiltration. Another significant point is the identification of the Frisch bacillus, which is always a positive finding of this disease. Its presence will help to differentiate this condition from ozena and thus enable one to institute early therapeutic measures. Early diagnosis is important particularly when, as Belinoff stated, the anatomicopathologic appearance, the Russell corpuscles, the Mikulicz cells or even the

Fig. 4.—Frisch bacillus cultured in an albuminous medium (horse serum with glycerin 5 per cent). The typical stearin drops can be seen.

Frisch bacillus may not be present either in the early stages of the disease, in the stage of atrophy or later, when there is degeneration of the tissue.

Although rhinoscleroma is still considered an insidious and incurable disease, presenting, according to many opinions, a fatal prognosis in spite of its slow evolution, there seem to be some evidences of cure, particularly when it is treated by means of radium and roentgen rays.

3. Szmurlo, J.: Histopathologie du sclerome, in Congrès international d'oto-rhino-laryngologie (1928), 1929, p. 134.

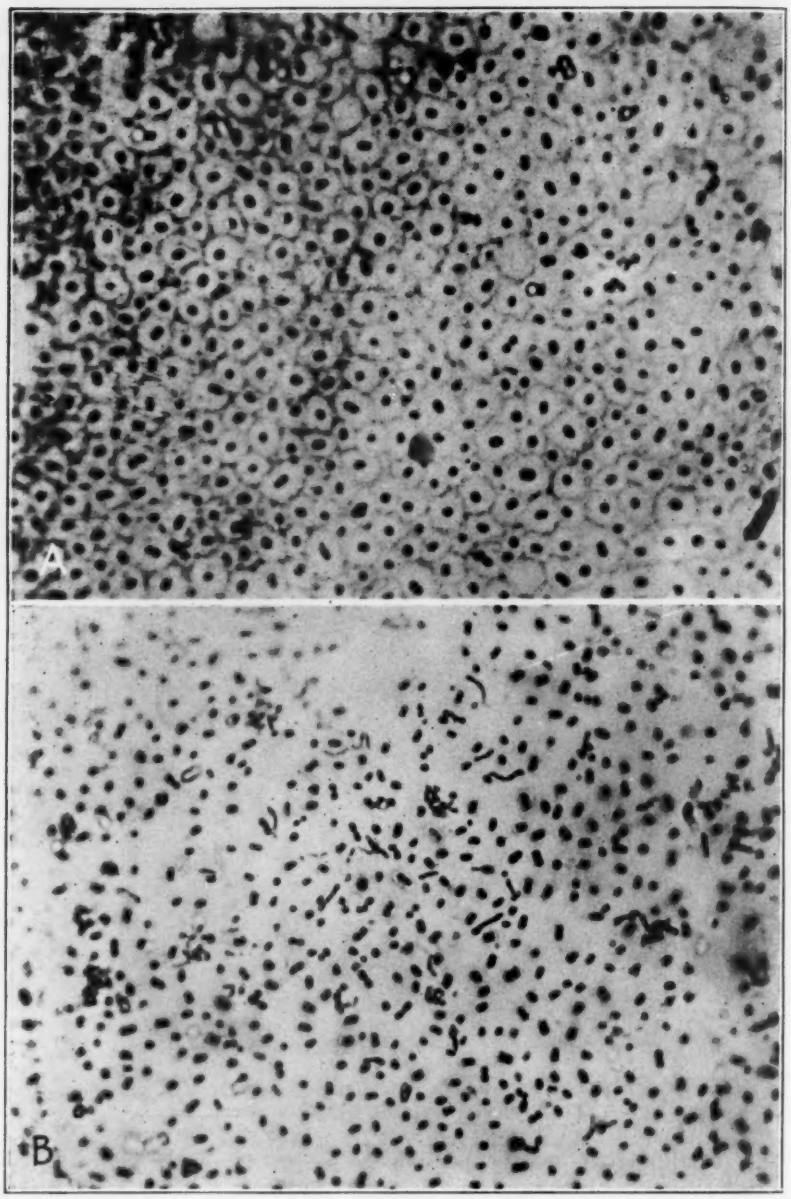

Fig. 5.—*A*, Frisch bacilli with capsular hypertrophy, cultivated in horse serum containing glycerin (5 per cent). *B*, Frisch bacilli with devolutionary elongated forms, developed in an old culture in a nonalbuminous medium (gelose).

In the present case, because of the similarity of the condition to leishmaniasis, fuadin was used, with surgical removal of the mass. At that time I thought that this was an original idea, but I have subsequently learned that Leimena and Sardjito [4] commented on its efficiency in 1937. In 1938 de Lima and Silva [5] commented on the use of fuadin, and although they questioned the benefits of medication, they noted that the secretions and the fetidness were considerably lessened. In 1942 J. K. Majia, of Honduras, and Bikford, of Guatemala, stated that rhinoscleroma could be cured by the use of fuadin.[6]

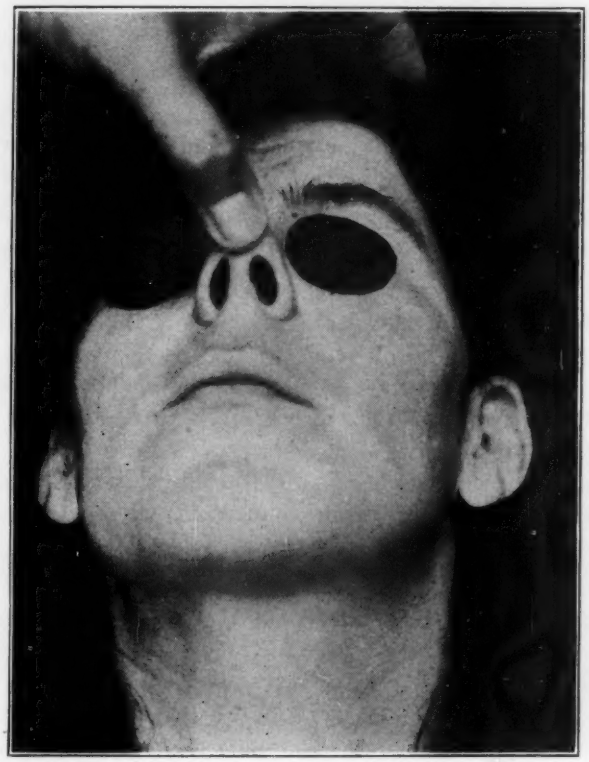

Fig. 6.—The patient in 1944, showing complete cicatrization of the nasal lesions.

I believe that the administration of fuadin should be supplemented by other measures, such as surgical removal, application of radium or electrocoagulation. This is particularly true in the presence of synechiae or actual polypoid growths. Other methods of treatment have been

4. Leimena, J. M., and Sardjito, M.: Rhinosclerom in Minahassa, Geneesk. tijdschr. v. Nederl.-Indië **76**:2010, 1936.

5. de Lima, E., and Silva, G.: Um caso de rhinoseleroma, Arq. Cong. brasil. de oto-rhino-laryng., 1938, p. 187.

6. Melo, V. F.: Informe sobre um caso interessante-rinoscleroma, Rev. de radiol. **9**:237, 1942.

reported by other investigators, among which may be mentioned "lopion" (sodium auroallyl thiourea benzoate), "solganol" (aurothioglucose) in oil and chaulmoogra oil, each of which has its advocates who claim excellent results. Finally, one must remember the case observed by Kuilman, Kaiser and Sardjito [7] in the Baoemmah region of Southern Sumatra in which a spontaneous cure was effected.

CONCLUSIONS

1. Of the 26 cases of rhinoscleroma reported in Brazil, 16 were autochthonous.

2. Although rhinoscleroma occurs in Brazil, it is not endemic in this country.

3. To substantiate the clinical and histologic examinations of a true case of rhinoscleroma, a microbiologic examination and isolation of the Frisch bacillus are necessary.

4. It is possible to cure rhinoscleroma by the combined use of drugs (such as fuadin), irradiation (radium and roentgen rays) and chemotherapy.

5. Supplementing the medical treatment, surgical removal of the growths is often necessary.

6. It would be interesting for investigators of this disease to determine whether or not the rhinolaryngotracheal involvement is a primary and unique manifestation of this disease or whether it is a secondary stage (mucous) of a cutaneous disturbance (ulcer) transmitted by mosquitoes which gives rhinoscleroma a character somewhat similar to that of leishmaniasis.

SUMMARY

The case of rhinoscleroma presented is the first among 16,000 patients. A survey of the incidence of rhinoscleroma in Brazil indicates that this country cannot be considered as one which has a true focus of the disease. The cultural aspects of the Frisch bacillus, particularly when it is grown in horse serum containing glycerin in the concentration of 5 per cent, are stressed as a diagnostic criterion. Chemotherapy, particularly the administration of some of the antimony compounds, such as fuadin, is of some value, but surgical treatment or irradiation should supplement it. Finally the suggestion is offered that rhinoscleroma may be a general disease transmitted by mosquitoes and that the rhinolaryngotracheal lesions render the secondary stage of the disease very similar to leishmaniasis. Colleagues, particularly those in the countries in which the disease is endemic, are urged to make further investigations in order to prove this concept.

Rua Visconde de Inhauma 59.

7. Kuilman, J.; Kaiser, P. J., and Sardjito, M.: Rhinoscleroma in de Pasoemah Highlands of Southern Sumatra, Geneesk. tijdschr. v. Nederl.-Indië **77**:770, 1937.

SALIVARY GLAND TUMOR OF THE MIDDLE EAR AND PAGET'S DISEASE (OSTEITIS DEFORMANS) OF THE SKULL

FRANK J. NOVAK III, M.D.
SAN FRANCISCO

TUMORS of the middle ear are relatively uncommon. Schall [1] reported that the incidence of cancer of the middle ear is 1 in 6,000 cases of disease of the ear. Ahlbom [2] analyzed 432 cases of mucous and salivary gland tumors and stated that the incidence of aural tumor was 1 in 215 cases. Salivary gland tumors are no more than 1 to 2 per cent of all tumors. The relative infrequency of aural cancer of this type plus the finding of histologically proved Paget's disease of the skull warrants recording.

Grabscheid [3] in 1943 reviewed some of the literature pertinent to neoplasms of the middle ear. Hemangioendothelioma, grade 2 and 3 squamous cell carcinoma, basal cell carcinoma and adenocarcinoma account for nearly all the types found. At the same time Grabscheid reported a case of adenocarcinoma of the middle ear which resembled the case which is reported here. The tumor which he described arose in the vicinity of the eustachian tube, whereas the one described here most probably arose more posteriorly, in the tympanic cavity, because the eustachian tube could easily be probed. However, the large size of the tumor in the present case leaves the exact site of origin in doubt. Politzer [4] described the glandular elements in the tympanic cavity which might have served as a focus for the epithelial nature of this tumor. In both cases, moreover, the mastoid process itself was intact, the mucosa showing only hyperemia and the bone being well pneumatized. The mastoid bone apparently was not involved in the Paget's disease. This process was largely confined to the vault of the skull.

Ahlbom [2] in 1935 wrote a comprehensive monograph on mucous and salivary gland tumors. He demonstrated that they are epithelial tumors and proposed a classification of benign, semimalignant and malignant tumors. The tumor described here is probably best described as a benign basaloma with cylindromatous features. Ahlbom defined this as a benign or a semimalignant encapsulated tumor resembling basal cell carcinoma.

From the Department of Otolaryngology, University of Illinois College of Medicine.

1. Schall, L. S.: Neoplasms Involving the Middle Ear, Arch. Otolaryng. **22:** 548-553 (Nov.) 1935.

2. Ahlbom, H. E.: Mucous and Salivary Gland Tumors, Acta radiol., 1935, supp. 23.

3. Grabscheid, E.: Adenocarcinoma Involving the Middle Ear, Arch. Otolaryng. **37:**430-433 (March) 1943.

4. Politzer, A.: Lehrbuch der Ohrenheilkunde, ed. 4, Stuttgart, Ferdinand Enke, 1901.

Prognostically, this tumor gives a good prospect with surgical excision. In Ahlbom's series of cases there were only 2 cases of aural occurrence and in these the tumor was malignant.

Ahlbom discussed the value of radiation in the after-care of the sites of salivary tumors. It is his opinion that many salivary tumors are more radiosensitive than previously thought. In the present case, because of the age of the patient, the benign nature of the tumor and

Fig. 1—Right ear showing tumor in situ.

the additional morbidity following use of radiation, surgical removal alone was deemed adequate.

REPORT OF A CASE

Mrs. B. N., a 75 year old music teacher, came to the ear, nose and throat clinic of the University of Illinois with the following complaints: For four years she had noticed a tumor growing from her right ear. In the beginning she had

severe pain but no discharge, and her hearing was equally good in both ears. The tumor began as a swelling the size of a grain of rice in the right external auditory meatus. About one year prior to the patient's admission to the hospital the tumor increased in size. Associated with this increase was severe pain. She sought no medical attention. Five months prior to her admission the tumor suddenly began

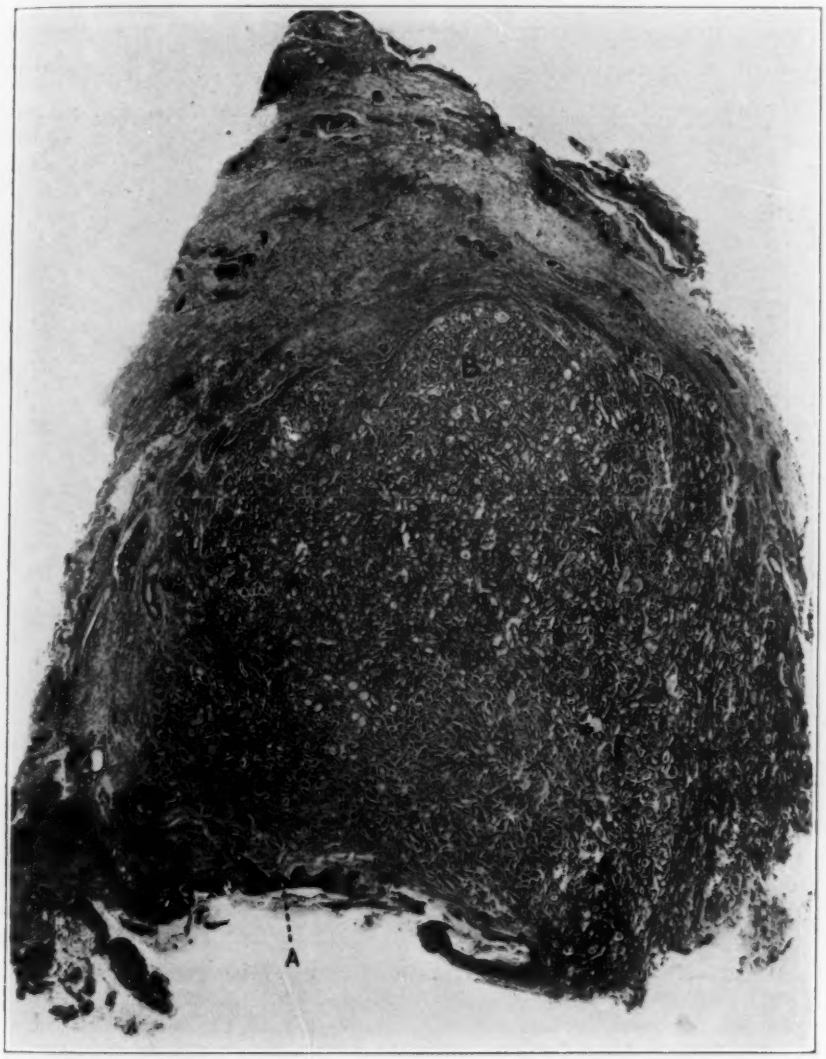

Fig. 2.—Photomicrograph of the surgical specimen (low power): *A* indicates a fragment of squamous epithelium; *B*, an area showing the glandular character of the tumor.

to grow and filled the external auditory canal. It also bled profusely at times. With the sudden increase in the size of the tumor, the hearing became impaired.

On Mrs. B. N.'s first visit to the clinic the following observations were recorded. She was somewhat deaf and had a large beefy tumor protruding from her right ear.

There was some dried blood on this tumor. Examination of the nose and throat revealed normal conditions for the patient's age. The left external auditory canal and drum membrane were normal.

The functional findings of the ears were as follows: The patient heard conversational voice at 5 to 7 feet (1.5 to 2 meters). She heard whispered voice at about 2 feet (61 cm.). In Weber's test the sound was lateralized to the right. Rinne's test was questionably negative in the right ear and positive in the left. A C_4 tuning fork could not be heard. The C_{64} fork was heard. The fistula test produced no nystagmus, and no spontaneous nystagmus could be observed.

Fig. 3.—High power photomicrograph of salivary gland tumor. *A* indicates a ductlike formation.

Rotation tests revealed that the labyrinths were equally excitable. No cervical glands were palpable.

General physical examination demonstrated only a third degree uterine prolapse. In all other respects the patient was in good physical health. Blood counts and urinalysis gave normal results. The Kahn and Wassermann tests disclosed no syphilis.

Roentgen studies revealed a soft tissue mass in the right external auditory meatus, chronic mastoiditis on the right side and what were thought to be possibly osteoblastic metastases in the posterior half of the skull.

Punch specimens were taken from several places in the tumor for biopsy. Microscopic examination showed the material to be that of a basal cell carcinoma, sweat gland type.

On Nov. 17, 1945 a radical mastoidectomy was performed through a post-auricular incision on the right side. The planum mastoideum was exposed. The posterior wall of the external auditory canal was elevated and its middle portion found to be absent and replaced by tumor tissue. The tumor was easily removed from the anterior-inferior wall of the canal but was attached to the superior posterior portion. At this site the tumor came away with surrounding skin. Next the antrum was opened, and in it were mucopus, necrotic bone and some granulation tissue. The mastoid process was well pneumatized, but the bone was

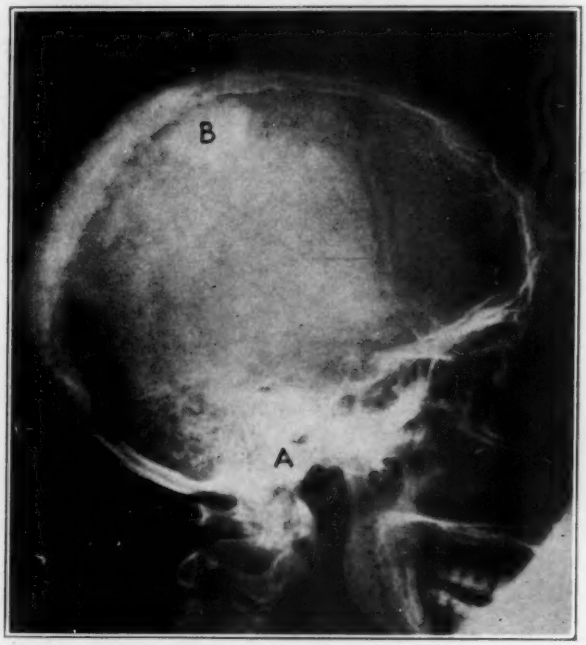

Fig. 4.—Roentgenogram of the right side of the skull. *A* indicates an area of chronic mastoiditis; *B*, a radiodense area of Paget's disease.

soft and the mucosa hyperemic. Cells in the petrosal angle, tegmen and retrofacial area were partly involved in the necrotic process. The dura of the middle fossa was exposed and appeared normal. As the mastoidectomy continued, no ossicles could be found. Only granulation tissue was present in the attic region. The horizontal semicircular canal, at its ampullary end, was seen covered with granulation tissue. This tissue extended to the oval window and to the eminence of the promontory. In the anterior portion of the tympanic cavity there was a sequestrum embedded in the granulation tissue which it was deemed inadvisable to remove. A probe passed easily into the eustachian tube. The skin covering the anterior wall of the bony canal was atrophic and thin because of pressure from the tumor.

Microscopic examination of the complete surgical specimen showed that the tumor was entirely covered with a thin layer of epidermis. Chronic inflammatory

changes characterized the mastoid cells, but no tumor invasion was apparent. At this time the diagnosis was changed from basal cell carcinoma, sweat gland type, to minor salivary gland tumor with cylindromatous features.

On Feb. 16, 1946 a small incision of the scalp was made in the right occipital region, and a piece of bone 1.5 cm. in diameter with the underlying medulla was removed. Histologic examination of this tissue demonstrated the characteristics of Paget's disease of the bone.

The patient's subsequent history has been uneventful. Pain and bleeding subsided promptly. Mrs. B. N. has even resumed her teaching of music.

SUMMARY

A case of minor salivary gland tumor with cylindromatous features occurring in the right middle ear of a 75 year old woman is reported. This rare and rather benign tumor was treated by radical surgical procedure. Coincidentally there was raised the problem of differential diagnosis of radiodense lesions of the cranium. The diagnosis was made by biopsy, which proved these lesions to be Paget's disease of the skull.

Progress in Otolaryngology

Summaries of the Bibliographic Material Available in the Field of Otolaryngology

TUMORS OF THE NOSE AND THROAT

GORDON B. NEW, M.D.
AND
EDWARD L. FOSS, M.D.
ROCHESTER, MINN.

A CASE of cystic hygroma of the neck with congenital lymphangiomatous macroglossia was reviewed by Lierle.[1] The patient was an infant 11 months old whose tongue was so large that it could not be retained in the mouth. The tumor of the neck was removed surgically. The tongue was treated, first, by divided doses of roentgen rays. Later, the anterior portion of the tongue was amputated, and a large wedge-shaped section was removed from the remainder. This procedure reduced the tongue to practically normal size. There had been no recurrence in four years at the time of Lierle's report.

Fourteen patients with adenoma of the salivary glands were operated on in seventeen years by Kent, Sawyer and Benwell.[2] The parotid gland was involved in 12; the submaxillary gland in 2. In all except 1 the lesion was well encapsulated. All were treated by extremely radical removal of the neoplasm. The 1 patient who had a recurrent tumor was cured by roentgen rays.

Hart[3] presented data concerning a group of rhinolaryngologic tumors of unusual clinical interest. The group included the following tumors: (1) metastatic hypernephroma of the frontal sinuses, (2) osteoma of the frontal sinuses, (3) metastatic melanoma of the sphenoid sinus, (4) neurinoma of the tongue and (5) cylindroma of the trachea.

In a paper written for the laity, Martin[4] discussed the problem of cancer of the skin, the lip and the tongue. The material was presented in an excellent manner.

From the Section on Laryngology, Oral and Plastic Surgery, Mayo Clinic.

1. Lierle, D. M.: Congenital Lymphangiomatous Macroglossia with Cystic Hygroma of the Neck, Ann. Otol., Rhin. & Laryng. **53**:574-575 (Sept.) 1944.

2. Kent, G. B.; Sawyer, K. C., and Benwell, J. S.: Mixed Tumors of the Salivary Glands: A Critical Review of Fourteen Surgically Treated Cases, J. Internat. Coll. Surgeons **8**:115-120 (March-April) 1945.

3. Hart, V. K.: Some Rhinolaryngological Tumors of Unusual Clinical Interest: A Small Series Presenting Infrequent Character, Difficulty in Management or Both, Tr. Am. Laryng., Rhin. & Otol. Soc., 1943, pp. 115-135.

4. Martin, H.: Cancer of the Skin, Lip and Tongue, Bull. Am. Soc. Control Cancer **26**:82-83 (July) 1944.

A method of radiotherapy has been evolved by Cutler which he calls the "concentration method." In a recent article [5] he said that this method had resulted in eradication of the more radioresistant carcinomas of the mouth, pharynx and larynx—lesions which had not responded to previous methods of external irradiation. The author concluded that it was still too early to be certain of the permanency of the results.

Davis [6] stated that in the presence of early and moderately advanced basal cell carcinoma, excision and plastic repair offer good chances for cure with minimal disfigurement. In the case of late repeated recurrences with marked destruction of tissue, he believed, prosthesis may be preferred to plastic repair.

Brown and McDowell [7] wrote that at present the block surgical excision of the lymphatic-bearing regions of the neck gives the best prospect of cure for the greatest number of patients who have metastatic carcinoma of the cervical lymph nodes. Brown and McDowell urged that this excision be done whether or not palpable nodes are present. The operation is accompanied by a low fatality rate in itself and produces a percentage of five year cures that is worth while.

TUMORS OF THE NOSE AND THE ACCESSORY SINUSES

Many methods of approaching the nasal cavity and paranasal sinuses have been devised for the removal of benign and malignant tumors and for the treatment of suppurative disease of the paranasal sinuses. Havens and Thornell [8] considered briefly the literature regarding these methods and described the method of approach which they have used with satisfaction in certain selected cases in which a malignant process has been found in the nasal cavity. In none of these cases was there any evidence of involvement of bone. They said that carcinoma occurring within the nasal cavity is most likely to be found on the septum or high on the lateral wall of the nasal passage. They discussed some of the clinical signs of malignancy. Roentgenograms of the paranasal sinuses, they wrote, are essential in cases of tumor. They observed a number of cases in which the sinuses of the side on which the lesion was situated appeared cloudy and those of the opposite side clear or

5. Cutler, M.: Concentration Method of Radiotherapy for Cancer of the Mouth, Pharynx and Larynx: Report of Progress, Am. J. Roentgenol. **51**:739-746 (June) 1944.

6. Davis, W. B.: Basal Cell Lesions of the Nose, Cheek and Lips, Ann. Surg. **119**:944-948 (June) 1944.

7. Brown, J. B., and McDowell, F.: Treatment of Metastatic Carcinoma of the Neck, Tr. South. S. A. (1943) **55**:254-266, 1944.

8. Havens, F. Z., and Thornell, W. C.: Malignant Tumors of the Nasal Cavity: Report of Eight Cases in Which a Frontoethmoid Approach Was Employed, Arch. Otolaryng. **40**:396-401 (Nov.) 1944.

comparatively clear. They expressed the belief that this appearance is of diagnostic importance and that it suggests obstruction caused by neoplasm rather than by an inflammatory process. Eight cases in which carcinoma was treated by the frontoethmoid approach were reported.

Ersner and Saltzman[9] reported the fourth case of mixed tumor of the nasal septum to be found recorded in the literature. The tumor was removed surgically.

TUMORS OF THE LIPS AND THE MOUTH

Three cases of ossifying fibroma of the upper jaw were reported by Harris and Hagaman.[10] In all the tumor was removed surgically after ligation of the external carotid artery.

Jacobs[11] reported 7 cases of giant cell tumor of the jaw. He discussed means of distinguishing two types of giant cell tumor. He recommended that in all cases a study of the blood be made for evidence of hyperparathyroidism and that roentgenograms of the pelvis, the long bones and the skull be made.

Two rare cases of solitary neurofibroma were discussed by Schroff.[12] In the first case a solid tumor was found beneath the mucous membrane of the mouth. It was situated above the submaxillary gland. In the second case the lesion, which was cystic, was contained within the ramus of the mandible. Roentgenographically, it resembled the ordinary large mandibular cyst or adamantinoma.

Thoma, Howe and Wenig[13] reported a number of interesting cysts and other tumorous lesions encountered about the mouth and the jaws. All the patients concerned were treated at the authors' clinic.

After study of 71 consecutive cases in which patients were treated for cancer of the lip at St. Anne's Hospital, Dublin, Douglas[14] concluded that contact roentgen ray therapy, radium treatment and surgical excision probably are equally satisfactory as methods of treatment. In the 71 cases reviewed, only 1 patient underwent surgical removal

9. Ersner, M. S., and Saltzman, M.: A Mixed Tumor of the Nasal Septum: Report of a Case, Laryngoscope **54**:287-296 (June) 1944.

10. Harris, R., and Hagaman, V. D.: Ossifying Fibroma of the Upper Jaw, (with Report of Three Cases), Tr. Am. Laryng., Rhin. & Otol. Soc., 1942, pp. 284-291.

11. Jacobs, M. H.: Giant Cell Tumors of the Jaws, Am. J. Orthodontics (Oral Surg. Sect.) **30**:317-328 (June) 1944.

12. Schroff, J.: Solitary Neurofibroma of the Oral Cavity (Neurilemmoma: Neurinoma), J. Am. Dent. A. **32**:199-202 (Feb. 1) 1945.

13. Thoma, K. H.; Howe, H. D., and Wenig, M.: Tumors of the Mouth and Jaws, Am. J. Orthodontics, (Oral Surg. Sect.) **31**:260-288 (April) 1945.

14. Douglas, S. J.: Cancer of the Lip, Brit. J. Radiol. **17**:185-189 (June) 1944.

of the primary lesion; in this instance removal was accomplished by diathermy excision.

Eckert and Petry [15] favored surgical intervention as the basic method of treatment for both primary carcinoma of the lip and the metastatic processes of the lesion. They also recommended that routine dissection of lymph nodes of the suprahyoid region of the neck be done in every case of early cancer of the lip even if the lymph nodes were not palpable. Careful follow-up examinations should continue to be made during the life of the patient.

Jorstad and Verda [16] said that radium emanation in the form of the gold radon seed implanted into the tongue has proved to be the most satisfactory method for the control of cancer of the tongue. They also regarded surgical resection of the lymph-bearing tissue of the secondary drainage zone (dissection of glands of the neck) as the treatment of choice for the control of metastasis.

Kemper and Bloom [17] reported a case of metastatic osteochondroma of the maxilla arising from a primary tumor of a tibia of a 13 year old white girl. The authors found no other reported case of osteogenic sarcoma metastasizing to the maxilla.

Beiswanger and Stenstrom [18] presented a review of 129 cases of carcinoma of the alveolar processes, the cheek, the floor of the mouth and the palate. All lesions were proved by biopsy to be carcinoma. A five year survival rate of 24 per cent was reported. The survival rate accompanying carcinoma of each site was reported. Various data as to treatment and complications were included in the discussion.

A series of nearly 5,000 cases of carcinoma of the mouth and jaws was reviewed by Somervell.[19] The author concluded that surgical operation has not the unpleasant after-effects of radiation and that it is always the method of choice except for a lesion of the tongue, the cheek or the tonsil and lesions occurring in a few special situations. A surgical procedure which is felt to be insufficient while it is being performed always can be reenforced by radium therapy. The author said that in the treatment of cancer, whether it is done with radium or by

15. Eckert, C. T., and Petry, J. L.: Carcinoma of the Lip, S. Clin. North America **24**:1064-1076 (Oct.) 1944.

16. Jorstad, L. H., and Verda, D. J.: Cancer of the Tongue: Its Diagnosis and Treatment, S. Clin. North America **24**:1077-1088 (Oct.) 1944.

17. Kemper, J. W., and Bloom, H. J.: Metastatic Osteochondroma of Maxilla from Primary Tumor of Tibia: Report of Case, Am. J. Orthodontics (Oral Surg. Sect.) **30**:704-708 (Nov.) 1944.

18. Beiswanger, R. H., and Stenstrom, K. W.: Carcinoma of the Cheek, Alveolar Processes, Floor of the Mouth and Palate, Radiology **44**:213-224 (March) 1945.

19. Somervell, T. H.: Recent Advances in the Treatment of Carcinoma of the Mouth and Jaws, Brit. J. Surg. **32**:35-43 (July) 1944.

operation, one must remember that error on the side of radicality is always safer than error on the side of conservatism.

Wiener [20] described the construction of the radium-bearing molds which he uses in the treatment of oral carcinoma.

TUMORS OF THE NASOPHARYNX

Foster [21] described a congenital nasopharyngeal dermoid which afflicted a 19 day old infant. The tumor, attached to a pedicle, was removed with a snare.

Clift [22] described a new type of nasopharyngeal applicator which he uses. The applicator consists of four parts: a brass capsule which is capable of holding five 10 mg. needles or a 50 mg. capsule of radium; a shaft of silver wire; a handle, and a sliding stop which automatically locks at any position desired. The applicator is inserted through the nose.

TUMORS OF THE LARYNX

Ferguson [23] reported 3 cases of hemangioma of the larynx. The treatment of hemangioma, in both the infant and the adult person, was discussed.

Four cases of cystadenoma of the larynx were reviewed by Figi, Rowland and New.[24] They said that cystadenoma of the larynx is extremely rare. It apparently develops as a result of cystic degeneration of a preexisting adenoma. The symptoms and the clinical course are those of any slowly progressive benign laryngeal tumor. In most cases, removal by means of suspension laryngoscopy is the most satisfactory form of treatment, although laryngofissure may be necessary in cases in which the tumor is extensive. When complete removal is achieved, the prognosis is good.

One hundred and five cases of tumor of the larynx were reviewed by Mitchell.[25] Eighty-three of the 105 tumors were malignant. The author concluded that the treatment of carcinoma of the larynx should be surgical whenever the extent of the lesion will permit operation.

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20. Wiener, K.: Cancer Treatment with Radium Bearing Moulds, Wisconsin M. J. **44**:297-300 (March) 1945.

21. Foster, J. H.: Congenital Dermoid Tumor of the Nasopharynx, Ann. Otol., Rhin. & Laryng. **53**:578-580 (Sept.) 1944.

22. Clift, M. W.: A New Nasopharyngeal Radium Applicator, Arch. Otolaryng. **40**:208-209 (Sept.) 1944.

23. Ferguson, G. B.: Hemangioma of the Adult and of the Infant Larynx: A Review of the Literature and a Report of Two Cases, Arch. Otolaryng. **40**:189-195 (Sept.) 1944.

24. Figi, F. A.; Rowland, W. D., and New, G. B.: Cystadenoma of the Larynx: Report of Four Cases, Arch. Otolaryng. **40**:445-450 (Dec.) 1944.

25. Mitchell, H. E.: Tumors of the Larynx: A Review of One Hundred and Five Cases, Tr. Am. Laryng., Rhin. & Otol. Soc., 1943, pp. 249-268.

McCall[26] stated that Hoerr and himself made roentgenoscopic studies of all laryngectomized patients who had developed esophageal voices. The esophageal voice of patients who had had training before laryngectomy was performed was found to be better than that of patients who had had no preliminary training. The results of these examinations were discussed.

The decision between laryngofissure, laryngectomy and irradiation in the treatment of cancer of the larynx as stated by Jackson and Blady[27] must be based primarily on the prospect of cure and secondarily on conservation of function. Criteria for the selection of treatment in a given case were reviewed.

LeJeune and Bayon[28] urged that specimens of tissue be taken from laryngeal lesions for biopsy before any surgical operation is undertaken. In some cases several specimens must be taken for biopsy before malignant tissue can be secured and a definite diagnosis made. LeJeune said that early lesions can be removed successfully by suspension laryngoscopy. The ideal condition for laryngofissure is one in which the lesion involves the middle portion of the vocal cord but in which both ends are uninvolved. Laryngectomy is indicated when the malignant lesion, although it is considered too extensive for performance of laryngofissure, is still confined within the cartilaginous structures of the larynx. Lagging of the involved cord and certainly fixation of the cord are indications that the lesion is too far advanced for laryngofissure to be successful. Another lesion which is too extensive for surgical removal is the so-called extrinsic type of carcinoma. Radiation is the only treatment which can be offered to patients who have the lesions in question.

Anatomic and physical studies of the types of radium implantation used at Mount Vernon Hospital and the Radium Institute, Northwood, Middlesex, in England, for the treatment of intrinsic carcinoma of the larynx were described by Morton, Gray and Neary.[29]

Definite carcinoma (or sarcoma) proved by biopsy in an otherwise operable patient is, in the opinion of Sherwin,[30] best treated by laryngofissure only if the lesion is small and easily removable; otherwise, total

26. McCall, J. W.: Preliminary Voice Training for Laryngectomy, Tr. Am. Laryng., Rhin. & Otol. Soc., 1943, pp. 45-55.

27. Jackson, C. L., and Blady, J. V.: Criteria for the Selection of Treatment in Cancer of the Larynx, Tr. Am. Laryng., Rhin. & Otol. Soc., 1942, pp. 317-324.

28. LeJeune, F. E., and Bayon, P. J.: Cancer of the Larynx, Tr. Am. Laryng., Rhin. & Otol. Soc., 1942, pp. 307-316.

29. Morton, J.; Gray, L. H., and Neary, G. J.: Consideration of Dose Distributions in Treatment of Intrinsic Carcinoma of Larynx by Radium Implantation, Brit. J. Radiol. **17**:204-212 (July) 1944.

30. Sherwin, C. F.: The Surgical Management of Cancer of the Larynx, S. Clin. North America **24**:1089-1099 (Oct.) 1944.

laryngectomy is preferred. In view of the improvements in operative technic in the past decade, an operative fatality rate of not more than 25 per cent should be expected among all patients so treated. Among those persons who survive the operation, 50 per cent should live five years or longer. Patients who recover can be rehabilitated and readjusted readily to fill responsible positions in earning a livelihood. The author discussed the operative steps to be followed in the performance of laryngectomy.

A special clamp has been developed by Vasconcelos and de Mattos Barretto [31] which is said to make it possible for them to remove the larynx without opening the pharynx. They expressed the belief that the clamp simplifies the technic of laryngectomy.

Howes and Platau [32] wrote that when carcinoma is localized, surgical operation offers the greatest opportunity for cure. It is therefore the policy at the Brooklyn Cancer Institute to excise the lesion when possible. Lesions too advanced for excision usually are referred for radiation therapy. Seventy-seven patients who had laryngeal carcinoma were admitted to the Brooklyn Cancer Institute from 1934 through 1942. Statistics derived from a review of the 77 cases were presented by Howes and Platau.

Clerf [33] observed laryngeal carcinoma in a 77 year old man. A specimen of tissue for biopsy had been removed from the patient's larynx ten years previously. At that time the tissue had been reported as carcinoma, and laryngectomy had been advised. The patient had refused surgical treatment. During the ensuing ten years additional symptoms had not developed; at the end of that period laryngectomy was done. Results of the original biopsy were checked, and the diagnosis was not changed. Clerf thought that the condition probably was Bowen's disease, which is regarded by many pathologists as being a highly specialized form of superficial squamous cell epithelioma with lateral intraepithelial spread.

CARCINOMA OF THE TRACHEA

Tinney, Moersch and McDonald [34] presented the results of a study based on a review of 27 cases in which some neoplasm of the trachea

31. Vasconcelos, E., and de Mattos Barretto, P.: Total Laryngectomy: Simplified Technics with the Use of a Special Clamp Which Makes Possible the Removal of the Larynx and Preepiglottic Space Without Opening the Pharynx, Arch. Otolaryng. **40**:275-281 (Oct.) 1944.

32. Howes, W. E., and Platau, M.: Carcinoma of the Larynx: A Review of Treatment and End Results at the Brooklyn Cancer Institute, Arch. Otolaryng. **40**:133-138 (Aug.) 1944.

33. Clerf, L. H.: Cancer of the Larynx: Report of Unusual Case, Ann. Otol., Rhin. & Laryng. **53**:335-338 (June) 1944.

34. Tinney, W. S.; Moersch, H. J., and McDonald, J. R.: Tumors of the Trachea, Arch. Otolaryng. **41**:284-290 (April) 1945.

had been seen at the Mayo Clinic since 1921. They concluded that carcinoma of the trachea constitutes an extremely difficult therapeutic problem and that no one form of treatment has been found satisfactory in all types of cases. Carcinoma situated in the upper portion of the trachea is best treated by tracheal fissure and electrocoagulative destruction of the tumor. Carcinoma situated in the lower end of the trachea is best treated by electrocoagulation of the tumor performed through the bronchoscope. The radon implant has been employed rather extensively, with questionable benefit. It does not seem advisable, however, to employ the radium pack or roentgen rays over the regional lymph nodes.

Two cases of fatal adenocarcinoma of the trachea and 1 case of basal cell carcinoma associated with a good prognosis were presented by Dean.[35] He reviewed the literature in this connection.

Pierson [36] presented a case of primary adenocarcinoma of the trachea in which as much tissue as possible was removed endoscopically. Radium was then applied intratracheally. The patient had remained well for two years at the time of Pierson's report.

Five patients who had cancer of the trachea and who were seen in private practice during a five year period were considered by Fisher.[37] He expressed the belief that satisfactory treatment consists of electrocoagulation of the lesion performed through the bronchoscope. This should be followed by irradiation of the tumor with roentgen rays of high voltage.

TUMORS OF THE ESOPHAGUS

Harper and Tiscenco [38] reported a case of leiomyoma of the esophagus. They described the morphologic features of this condition as observed in radioscopy and in spot films. They discussed the fundamental problems involving the differential diagnosis.

Seven cases of benign tumor of the esophagus were presented by Harrington and Moersch.[39] In 5 of these, esophagotomy was performed; in 1 case resection of the esophagus was employed; in 1 case the tumor was removed perorally with a snare and cautery. Benign tumors of the

35. Dean, L. W., Jr.: Adenocarcinoma of the Trachea: A Pathological Classification of Assistance in Treatment and Prognosis, Ann. Otol., Rhin. & Laryng. **53**:669-678 (Dec.) 1944.

36. Pierson, P. H.: Primary Carcinoma of the Trachea: Treatment with Intratracheal Radium; Radio-Active Iodine Fails to Show Thyroid Origin, J. A. M. A. **126**:206-209 (Sept. 23) 1944.

37. Fisher, G. E.: Cancer of the Trachea: Report of Five Cases, Arch. Otolaryng. **40**:49-51 (July) 1944.

38. Harper, R. A. K., and Tiscenco, E.: Benign Tumour of the Oesophagus and Its Differential Diagnosis, Brit. J. Radiol. **18**:99-107 (April) 1945.

39. Harrington, S. W., and Moersch, H. J.: Surgical Treatment and Clinical Manifestations of Benign Tumors of the Esophagus with Report of Seven Cases, J. Thoracic Surg. **13**:394-414 (Oct.) 1944.

esophagus, they wrote, can be divided into two types: those arising from the mucosa or the submucosa, and those arising from the outer coats of the esophagus. The latter often are called intramural, extramucosal tumors. The mucosal tumors are more likely to give rise to dysphagia than are those arising from the outer coats of the esophagus. These types of esophageal tumor may reach considerable size without producing symptoms. Moersch and Harrington [40] also reviewed 15 cases of benign tumors of the esophagus in which the diagnosis was based on clinical observations.

A detailed discussion of the treatment of esophageal carcinoma by irradiation was given by Lederman and Clarkson.[41] The results obtained in the treatment of 68 persons were presented in tabular form.

Twenty-six cases of secondary cancerous involvement of the esophagus were analyzed by Toreson.[42] Of the 26 cancers, 24 were carcinomas, 1 was a lymphosarcoma and 1 was a cancer of undetermined origin and type, probably a melanoma. The organs in which the tumors originated and the number of tumors found in each organ in the total series were as follows: trachea or bronchus, 8; stomach, 7; larynx, 4; breast, 2; pancreas, 2; testis, 1; mediastinal lymph nodes, 1; and origin undetermined, 1.

Twenty-eight cases in which carcinoma of the esophagus was surgically explored were reported by Adams.[43] He expressed the belief that in certain cases carcinoma of the esophagus has proved amenable to surgical excision. He expressed the opinion that successful surgical extirpation offers the only hope to this group of patients.

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40. Moersch, H. J., and Harrington, S. W.: Benign Tumor of the Esophagus, Ann. Otol., Rhin. & Laryng. **53**:800-817 (Dec.) 1944.

41. Lederman, M., and Clarkson, J.: Radium Treatment of Cancer of the Oesophagus, Brit. J. Radiol. **18**:22-28 (Jan.) 1945.

42. Toreson, W. E.: Secondary Carcinoma of the Esophagus as a Cause of Dysphagia, Arch. Path. **38**:82-84 (Aug.) 1944.

43. Adams, R.: Carcinoma of Thoracic Esophagus: Clinical Observations and Experiences with Twenty-Eight Surgically Explored Cases, S. Clin. North America **24**:684-693 (June) 1944.

Abstracts from Current Literature

Ear

MALINGERING AND PSYCHOGENIC DEAFNESS. LEO DOERFLER and KENNETH STEWART, J. Speech Disorders **11**:181, 1946.

Four measurements of audition are made in the D-S test. They are: (1) the speech reception threshold, (2) the noise perception threshold, (3) the noise interference level and (4) the repeat speech reception threshold. The relationships between these measurements are used as the basis for isolating causes of psychologic deafness. One or more of the following conditions raise the suspicion that the patient exhibits nonorganic loss:

1. Speech reception is inhibited by a noise interference level less intense than the speech presentation level.
2. The noise perception threshold is poorer than the speech reception threshold.
3. There is sharp discrepancy between the two speech reception thresholds.

Variations of the technics presented have been used successfully. Even more definition can be achieved by interpreting the D-S test in conjunction with an associated audiogram and a medical history. Treatment of psychogenic losses encountered at Deshon General Hospital has become more precise and rapid since the D-S test was incorporated as a clinical routine. Basically, the D-S test determines four measurements of audition. These are: (1) the speech reception threshold, (2) the noise perception threshold, (3) the noise interference level, (4) the repeat speech reception threshold. A continuous series of spondees is spoken 5 decibels above the speech reception threshold. Simultaneously, the masking noise is introduced and then gradually increased. This procedure is continued until the masking noise reaches a level where it inhibits speech reception and prevents repetition of the words by the patient.

PALMER, Wichita, Kan.

BLAST INJURIES OF THE EAR. G. A. HENRY, Laryngoscope **55**:663 (Nov.) 1945.

Major Henry presents impressions gathered from observation of 292 men who had sustained air blast injury of the ear.

Tinnitus was the most common symptom encountered. If the drum membrane was perforated, cellophane applied over the perforation immediately stopped the tinnitus. Vertigo was not common, and when present, usually was of short duration. Likewise, bleeding was uncommon. It occurred as a result of a tear in the drum membrane. Headache and aural pain were occasionally present. About half of the men had a perforation of one drum membrane; in a few both membranes were involved. In none was Shrapnell's membrane perforated. Some had congestion of the blood vessels about the handle of the malleus or hemorrhagic areas of the drum. The damage of the drum membrane followed a fairly regular pattern, depending on the severity of the blast.

External otitis occurred in a few of the patients. It was confined to the outer two thirds of the canal. Those with dry perforations were instructed not to blow the nose and not to get water in the ears. Powdered sulfonamide compounds were avoided. No cotton was placed in the external canal. Occasionally, with the slower healing perforations, a piece of cellophane was placed over the opening. In some instances this seemed to hasten the healing. If the ear was infected, cleansing was employed. Occasionally, a sulfonamide drug or penicillin was used. In a few instances mastoidectomy had to be done. Almost all save the very large perforations closed in a reasonable time.

The hearing loss incurred did not correspond to the damage done to the ear drum. It was a combination of conductive and perceptive deafness. About two thirds recovered completely. Of the remaining one third, most suffered only a slight degree of hearing loss.

HITSCHLER, Philadelphia.

DEAFNESS DUE TO MENINGOCOCCIC MENINGITIS TREATED WITH SULFONAMIDE DRUGS. T. ARTURO TELLO, Rev. de otorrinolaring. **6**:33 (June) 1946.

During the epidemic of meningococcic meningitis which occurred in Chile in the years 1941 and 1942 the author had an opportunity of studying some of the neurolabyrinthine complications associated with this disease. He found that in spite of the remarkable effects of the sulfonamide drugs on both the course and the cure of this disease, otitic complications still occurred, but the incidence of these complications was definitely decreased to 2.04 per cent. In his series of 1,068 patients with meningitis, 32 had symptoms of neurolabyrinthitis. Of these, total permanent deafness was observed in 22, but a partial cure was effected in 10. In the latter group, he observed that the hearing acuity did not reach its normal level and that, in spite of the apparent cochlear recovery, the vestibular involvement was of a permanent nature. Although intensive sulfonamide therapy, because of its rapid bacteriostatic action, can prevent permanent damage to the inner ear, deafness and destruction of the labyrinth cannot be avoided. This, the author felt, was probably due to additional factors occurring in the pathogenesis. His studies showed first that the composition of the perilymphatic fluid was similar to that of the spinal fluid; hence any meningeal complication of a tuberculous, a meningococcic, a pneumococcic or a hemorrhagic origin produces alteration in the perilymphatic fluid similar to that in the spinal fluid, such as an increase in the globulins, etc. These alterations indicate a true inflammatory process. This observation is contrary to the opinion of Rius, who felt that the perilymphatic space acts as a protective filter. The second factor that influences the internal ear in the meningococcic meningitis is intracranial hypertension. Thus there is a triad which can produce alteration in the perilymphatic space and in the spinal fluid, this triad consisting of infection, intracranial hypertension and chemical alterations. In neurolabyrinthitis the infectious factor can act directly on the eighth nerve or on the labyrinth, causing irreparable damage. While this factor may be eliminated by the timely use of sulfonamide drugs, the hypertensive factor is still present, and this frequently is shown to produce the infection in the perilymphatic space and may show itself by an increase in the globulins. These two factors—infection and hypertension—are the principal reasons for the production of neurolabyrinthitis. In the cases of spontaneous cure of deafness the hypertensive factor probably is predominant, and with the release of this the cochlea can return to a practically normal condition. However, the pathologic process in the vestibule is not reversible, since anatomically there is a difference of structure between the perilymphatic space of the vestibule and that of the cochlea. In the vestibule there is a fine connective tissue network which unites the membranous labyrinth with the bony wall. This is absent in the cochlear system. Because of this the perilymph can circulate freely in the cochlea, while in the vestibule its displacement is impeded because of the mesh of trabeculae. It is possible that, owing to this anatomic difference, the hypertensive process is prolonged in the vestibule and greater opportunity for greater permanent damage thus established.

With this thought in mind, Tello employed a dehydrating regimen in several of his cases, comprising low intake of fluids, intravenous injection of a 25 per cent dextrose solution, repeated spinal puncture and oral administration of 50 per cent magnesium sulfate. He observed marked improvement in 2 patients.

PERSKY, Philadelphia.

Larynx

KERATOSIS OF THE LARYNX. LOUIS H. CLERF, J. A. M. A. **132**:823 (Dec. 7) 1946.

Clerf discusses the various grades of epithelial hyperplasia of the larynx as they are observed clinically, the causes, the precancerous lesions, the pathologic aspects

and the treatment, illustrating with case reports and photomicrographs. In the report of cases he comments on those in which the condition responded to conservative therapeutic measures, those in which frequent removal of mucosal and submucosal tissues was required, the ones in which the process was not frankly carcinoma but required more radical therapeutic measures and finally those in which there was exhibited histologic evidence of carcinoma.

He concludes that keratosis of the larynx is a relatively common benign condition, more often observed in men and in those who smoke excessively. Some experimental and clinical evidence seems to point to a metabolic disease or a food deficiency as a cause. Clinically, in some of the cases the keratosis is benign, whereas in other cases it is likely to become carcinomatous or to predispose to development of carcinoma. No pathologist can anticipate what mucosal or submucosal changes might take place or develop, and often it is difficult to differentiate between early carcinoma and simple keratosis.

Patients with keratosis should be kept under close observation; the involved areas should be removed and all tissue examined histologically, and when there is any question of carcinoma, more surgical intervention is indicated.

GORDON, Philadelphia.

SPEECH AFTER LARYNGECTOMY. JACK L. BANGS, D. M. LIERLE and C. R. STROTHER, J. Speech Disorders **11**:171, 1946.

This article covers the use of the artificial larynx, esophageal speech and the electrically driven voice box. Patients about to undergo laryngectomy are told what they may expect relative to the recovery of voice functions after the operation.

PALMER, Wichita, Kan.

MYASTHENIA LARYNGIS: A CASE REPORT. JAMES H. PLATT, J. Speech Disorders **11**:187, 1946.

The patient's use of his voice was first restricted to an unstrained whisper; then a program of progressive relaxation was undertaken, then training in diaphragmatic breathing. Rolling the head from side to side and humming exercise were given. The humming exercise consisted of humming at a comfortable pitch for five minutes every waking hour over a period of six weeks. When the initiation of tone became consistently smooth, simple monosyllabic words containing medial vowel sounds were introduced into the exercises. One word was spoken on each expiration of breath, with prolongation of the vowel sound. Then short sentences were read in chant and later with slight variations of pitch and volume. The patient has been cautioned against overuse and strain of the voice. He is at present improving.

PALMER, Wichita, Kan.

SPONTANEOUS RUPTURE OF THE ESOPHAGUS. E. L. ELIASON and B. F. WELTZ, Surg., Gynec. & Obst. **83**:234 (Aug.) 1946.

Spontaneous rupture of the esophagus occurs at the lower end, usually within an inch or two of the cardia. It usually results from a sudden increase of pressure such as is induced by retching or vomiting. The epigastric or substernal pain may radiate to the back or to the interscapular region. Food particles may be found in the posterior mediastinum. Rupture into the pleural cavity is not uncommon, and even though the pleurae are not actually invaded, pleural effusion may result from adjacent mediastinal irritation. Shock is severe, and dyspnea and cyanosis accompany an increase of the respiratory rate. Subcutaneous emphysema occurs in approximately half the cases. Roentgen examination may reveal air in the mediastinum or a fluid level. Differential diagnosis includes coronary occlusion, dissecting aortic aneurysm, pulmonary embolism, ruptured peptic ulcer, acute pancreatitis, spontaneous pneumothorax and mesenteric occlusion.

In reporting 3 fatal cases seen in one year, the authors state that early recognition and diagnosis of the condition will probably lead to reports of recoveries in the near future. Effective chemotherapeutic and supportive agents plus surgical intervention offer the greatest hope, provided an early diagnosis can be made.

FRIEDBERG, Chicago.

Nose

THE USE OF PENICILLIN AEROSOL IN BRONCHOPULMONARY AND SINUS INFECTIONS. ALVAN L. BARACH, BETTINA GARTHWAITE and COLTER RULE, New York State J. Med. **46**:1703 (Aug. 1) 1946.

Barach, working in the medical department of Columbia University and in the Presbyterian Hospital, has been an ardent student of "inhalational therapy" for several years. The present "report" covers 6 cases only, but is scrupulously detailed in the "work-up." Results of a current further investigation with penicillin will be ready for publication shortly. In this analysis much space is given to "methods of procedure." At present the drug is humidified by passing it over hot water. Further, large particles are more finely divided by a "baffle" connected to a conventional nebulizer, "both procedures aimed to avoid irritation and red tongue." Illustrations show the apparatus now in use. Roentgenograms demonstrate intranasal negative pressure before and after treatment of acute and chronic sinusitis. "The advantages of administering penicillin by inhalation can be clearly discerned in lung abscess, in sinusitis, and in selected cases of bronchiectasis, in each of which bacteria may grow on a fibromucopurulent surface that is reached only by capillary blood supply."

VOORHEES, New York.

OSTEOMYELITIS OF THE SPHENOID BONE. EDUARDO MORALES, Rev. de otorrinolaring. **6**:1 (March) 1946.

The author presents a case. A 14 year old boy in 1943 had an attack of grip with high fever, difficulty in swallowing and pain in the left ear. The following day he presented evidence of a small left peritonsillar abscess, which was incised, with liberation of a few drops of pus. The culture of the pus was negative. However, his symptoms increased, and there developed edema of the left half of his skull, neck and face, with evidences of meningismus (rigidity of the neck, positive Kernig and Brudzinsky signs), but a culture of the spinal fluid was negative. There was papilledema of the left eye. The blood studies revealed 14,000 leukocytes with a definite shift to the left. The sedimentation rate was 42 mm. in one hour. The author's first impression was that he was dealing with extensive thrombophlebitis involving the left internal jugular vein, the left lateral sinus and the left cavernous sinus. The patient was treated with sulfonamide compounds, receiving 8 Gm. daily for ten days. The symptoms diminished, the fever subsided, the meningismus disappeared, but there was a marked residual swelling in the left parotid region. This was incised but no pus was obtained. However, as a result, facial paralysis and salivary fistula developed. The patient continued in apparent good health except for the fistula and paresis for about five months, when suddenly he was seized with a typical epileptiform attack. A neurosurgeon was consulted, and the following diagnoses were considered as possible: a latent embolus, a cerebral abscess, a meningoencephalitic scar. Roentgenograms of the skull and affected regions were taken, but these revealed no abnormality. This attack did not recur, but the edema and the fistula persisted. Two months later there was a considerable increase of the swelling of the parotid region and the eyelids, and exophthalmos appeared without any fever. Sulfonamide drugs were again administered, and this time other diagnoses were suggested, such as osteomyelitis and osteoperiostitis of local origin. A tonsillectomy was performed, but there was no alteration of the symptoms. However, shortly after this a fistula occurred at the external angle of the left orbit, and a culture of the pus showed staphylococci. Another episode occurred shortly afterward, nine months after the onset of the original symptoms. This was char-

acterized by pain and edema of the right temporal region, radiating to the right upper eyelid. This was incised without obtaining any pus. There followed an interval of about eight months in which the edema of the left frontal temporal region continued, as also the exophthalmos and the discharging fistula of the left orbital angle and the salivary fistula. Two additional symptoms appeared, namely, a moderate postnasal drip and a discharge of small hard fragments whenever the patient blew his nose. These had the appearance and consistency of bony tissue. With this clinical picture the author considered the possibility of osteomyelitis of the sphenoid bone. In 1944, or about one and a half years after the onset of symptoms, there was a fourth recurrence of the previous symptoms, but this was controlled with penicillin. Somewhat later the patient was subjected to a complete transantral ethmoidectomy and sphenoidectomy according to the daLima technic, but no frank pathologic process was found at the time of operation. About a year later the patient had another recurrence of his local and general symptoms, which again responded to a million and a half units of penicillin. At this time the author was able to make a clearcut diagnosis of osteomyelitis of the sphenoid bone involving principally the left wing and having a fistula through the left orbit. The patient was given 30,000 units of penicillin every four hours until he had received 5,000,000 units with little or no lessening of the edema or the exophthalmos. The author then decided to inject 10,000 units of penicillin daily into the temporal region. He made intraorbital injections extending beyond the external wall of the orbit until the drug reached the sphenoid bone. Both the temporal edema and the exophthalmos gradually subsided, and the patient is apparently cured. The author believes that the cure was effected primarily by the local action of the penicillin.

PERSKY, Philadelphia.

Miscellaneous

BRONCHIECTASIS FOLLOWING PRIMARY TUBERCULOSIS. EDNA M. JONES, W. M. PECK and H. S. WILLIS, Am. J. Dis. Child. **72**:296 (Sept.) 1946.

The authors studied 37 children in the Maybury Sanatorium, Detroit. The diagnosis of bronchiectasis was made by bronchoscopy and by roentgen examination after injection of iodized poppyseed oil. There were two groups of symptoms: those due to an obstructed bronchus; those due to ectasia. With the first group there were high fever, wheezing, cough, expectoration, which disappeared with subsidence of the tuberculosis, and pneumonitis. With the second there were repeated attacks of pneumonitis, hemoptysis, recurrent colds, fever, cough and much mucus. The authors state: "Bronchiectasis occurs in an unusually large number of children having pulmonary tuberculosis." Baum and Amberson (*Am. Rev. Tuberc.* **45**:243 [March] 1942) have reported 32 cases in which preexisting bronchiectasis was followed by pulmonary tuberculosis; however, the patients were all adults. The pathologic process may be granulomatous (tuberculoma), ulcerative, edematous or inflammatory. A tracheobronchial lymph node may erode the bronchial wall. Obstructive pneumonitis is commonly observed. As to prophylaxis, an effort must be made to open up obstructed bronchi. Medically, one may try steam inhalations, judicious use of theophylline ethylenediamine and postural drainage, with elevation of the foot of the bed. The bronchoscope will determine the degree and the kind of obstruction, and the bronchoscopist will remove a tuberculoma if that is present. Collapse of the lung is recommended only as a last resort, since partial obstruction may thus be converted into complete obstruction.

VOORHEES, New York.

CORRECTIVE SURGERY OF THE EXTERNAL NASAL PYRAMID AND THE NASAL SEPTUM FOR RESTORATION OF NORMAL PHYSIOLOGY. M. H. COTTLE and R. M. LORING, Illinois M. J. **90**:119 (Aug.) 1946.

The authors present an excellent illustrated review of established methods for performing a typical rhinoplasty. The article adds nothing original to the subject of plastic surgery of the nose.

SELTZER, Philadelphia.

PENICILLIN SPRAY IN RESPIRATORY INFECTIONS. F. W. MORSE, J. A. M. A. **132**: 272 (Oct. 5) 1946.

Morse describes the use of a hand-operated bulb atomizer filled with penicillin sodium spray. The patient inhales deeply after first exhaling as completely as possible. During the time of deep inhalation the bulb is compressed one or more times to drive a fine film of the penicillin sodium spray down the hypopharynx into the lungs. In cases of infection of the lower respiratory tract, including all portions of the fauces and the pharynx, the inhalation is accomplished through the mouth. In cases of involvement of the eustachian tube the spray is driven into the nose.

He describes the practical value of the bulb atomizer (De Vilbiss no. 15 or Atlas no. 82—De Vilbiss made). He speaks of the absorptive properties of the lung, directing attention to the fact that the inner surface of the lung has an area five hundred times as great as the body surface, and states that drugs given as aerosols are absorbed so rapidly that their effect is similar to that of intravenous injection. Further discussions of experimental and other data and of the advantages of this method as an adjunct to rational therapy and technics are given. Several case histories are cited. The matter of dosage has not been finally settled, since no dosage is absolute. The author has been content to use smaller doses: a twenty-four hour dose of 100,000 units of penicillin, with spraying every four hours, for the severe pneumonias; a twenty-four hour dose of 60,000 units, with spraying every four hours, for severe sinusitis; the same for severe laryngitis; a twenty-four hour dose of 40,000 units for moderate sinusitis and laryngitis.

GORDON, Philadelphia.

THE USE OF GELATIN SPONGE IN NEUROSURGERY. W. D. ABBOTT and F. C. COLEMAN, J. A. M. A. **132**:329 (Oct. 12) 1946.

The authors describe a hemostatic agent composed of gelatin pledgets and topical thrombin which they have found of value in 83 varied neurosurgical cases. They found no evidence of tissue reaction or of infection subsequent to its use. It was satisfactory in venous oozing only, not in arterial bleeding.

It is prepared as follows: A sheet of gelatin U. S. P. 22 cm. by 0.1 cm. is cut into strips 1 cm. wide and 3 cm. long. These are placed in a pyrex test tube, and 35 cc. of distilled water is added. Care must be taken that all the gelatin is below the surface of the water. The tube is placed in a boiling water bath for ten minutes. The liquefied gelatin is then poured into a sterile Petri dish. It is allowed to cool and is stored in a cool place until needed. When the gelatin is needed, it is removed from the Petri dish and placed on the instrument tray in a sterile container, so that a piece of the desired size may be obtained. To 1 ampule of thrombin topical, containing 5,000 Iowa units, is added 5.0 cc. of isotonic solution of sodium chloride, giving a concentration of 1,000 Iowa units per cubic centimeter. The gelatin is placed in the thrombin solution for at least one minute before it is used at an operation.

GORDON, Philadelphia.

INFANT SPEECH EQUATIONS FOR CONSONANT-VOWEL RATIOS. ORVIS C. IRWIN, J. Speech Disorders **11**:177, 1946.

Two indexes of speech development, the consonant-vowel type ratio and the consonant-vowel frequency ratio, have been applied to data obtained on the speech of 95 infants during the first two and a half years of life. The equations derived from the means of the bimonthly ratios are

$$\frac{C_T}{V_T} = 36.19A^{0.439} + 21.4 \text{ and } \frac{C_F}{V_F} = 5.4A + 19.4$$

The curve representing the first equation is curvilinear and that representing the second rectilinear, indicating that progress as measured by these ratios is not the same. The equation for the consonant-vowel type ratio is actually more complex than the one presented, but it was selected because of its goodness of over-all fit

in spite of its irregularity. Caution should be observed when drawing any applied or clinical implications from this portion of it, however.

PALMER, Wichita, Kan.

SPEECH COMES TO A FIVE YEAR OLD BOY. RUTH BECKEY IRWIN, J. Speech Disorders **11**:197, 1946.

A boy 5 years old, apparently normal physically and mentally, did not speak except for the word "mama," using grunts and gestures for communicating ideas. The mother was extremely nervous during the child's early life. The parents and the grandparents discussed the boy's inability to talk in his presence. The child's needs were anticipated by associates. Bribes, ridicule, praise and punishment had been used by the mother on the child. For several weeks no attempt was made to secure speech responses; play only was used. A Charley McCarthy doll was used while confidence was developed. Blowing exercises were brought in. The mother was instructed not to pay attention to his grunts. Constant reward was used as phonetic drill was begun and efforts to speak were made. After eight months he took a Stanford-Binet intelligence test and made a score of 106, and at the last session, eight months after the first trip to the speech office, he was talking spontaneously.

PALMER, Wichita, Kan.

NUTRITION IN OPHTHALMOLOGY AND OTOLARYNGOLOGY. ISAAC H. JONES, HAROLD S. MUCKLESTON, EUGENE R. LEWIS and GILBERT ROY OWEN, Laryngoscope **55**:599 (Nov.) 1945.

In an interesting paper Jones and co-workers discuss and review in detail the subject of nutrition from the points of view of ophthalmology and otolaryngology.

The first part deals with nutritional diseases seen and studied among the American civilian internees and prisoners of war of the Japanese. There were many cases of various avitaminoses and diseases due to malnutrition. It is pointed out that frequently health could not be maintained without proper foods, particularly proteins, no matter how high the intake of vitamins. There were some cases of perceptive deafness, but whether or not these were due to deficiency of vitamin B could not be determined. No other conditions affecting ear, nose or throat were encountered that could be attributed to avitaminoses. Faulty vision due to vitamin A deficiency was frequently seen. There were some cases of retrobulbar neuritis. Pellagra, beriberi and scurvy were common.

The remainder of the paper deals with nutrition in general, and not particularly with that related to the war. It is emphasized in regard to vitamins that if there is no deficiency there is no cure to be had from vitamins. Deficiency of vitamin B_2 may produce, among other things, seborrheic accumulations in the nasolabial folds and around the eyelids and the ears. The Americans' use of white instead of whole wheat or whole rye bread is deplored. Certain lesions of the skin have been associated with vitamin A deficiency. A combination of a sulfonamide compound and ascorbic acid has been used successfully in the treating of mastoiditis and chronic otitis media. Large doses of vitamin C, if given early, may shorten the common cold. This vitamin may also be a useful adjunct in the treatment of Vincent's angina. Vitamin A has been used in the treatment of "persistent sniffles." Avitaminoses may be an etiologic factor of certain cases of atrophic rhinitis. Vitamin B can be expected to improve hearing and lessen tinnitus only in cases of latent beriberi. The treatment of allergic conditions, including Ménière's syndrome, is discussed.

HIRSCHLER, Philadelphia.

PUTRID LUNG ABSCESS SUPERIMPOSED UPON A PULMONARY INFARCT. SAMUEL LEVINE and LAURENCE A. LERNER, New York State J. Med. **46**:1833 (Aug. 15) 1946.

The authors state that there is a divergence of opinion as to whether putrid abscess of the lung is due to an embolus or to a bronchiogenic cause. The case

which they report is unique in that a pulmonary infarct became infected and produced an abscess in the absence of any cardiac abnormality. The patient was admitted to Beth Israel Hospital, and the following day underwent cholecystectomy and appendectomy. The postoperative course was uneventful until the ninth day, when there was sudden pain in the right side of the chest with fever (102 F.). The diagnosis was "bronchopneumonia, pleural thickening, right base." Sulfadiazine was given, with some improvement, but symptoms continued well into the fourth week, indicating a smouldering condition of some kind. During the fourth week his temperature rose to 103 F., with pain, cough and shallow respiration. Roentgen examination revealed left pleural effusion. The patient was transferred to Mount Sinai Hospital, where posterior thoracotomy disclosed a large hemorrhagic pulmonary slough with a foul purulent abscess at its center. The slough was removed, the cavity was packed and eventually it healed by granulation until closed. Penicillin was given both before and after operation. Five months later the man was symptom free and back at work. A roentgen film of the chest showed an essentially normal condition save for the evidence of scars and fibrous tissue.

VOORHEES, New York.

News and Comment

AN INTENSIVE COURSE IN AUDIOMETRY AND FITTING OF HEARING AIDS

During the 1947 Summer Session the departments of speech, psychology and otolaryngology of the State University of Iowa are again offering an intensive four week course in audiometry and the fitting of hearing aids. The course will run from June 23 to July 19 and is open to any one meeting college entrance requirements.

A series of week end lectures and round table discussions on various aspects of the conservation of hearing will be featured as a part of the summer program. Mrs. Spencer Tracy, director of the John Tracy Clinic, Los Angeles; Dr. Helen Lane, principal, Central Institute for the Deaf, St. Louis; Dr. Werner Mueller, associate in otolaryngology, Massachusetts Eye and Ear Infirmary and Harvard Medical School, Boston, and Dr. Martin F. Palmer, director of the Institute of Logopedics, the Municipal University of Wichita, Wichita, Kan., will be the speakers.

Inquiries may be addressed to Jacqueline Keaster, assistant professor of speech and otology, Speech Clinic, State University of Iowa, Iowa City.

POST-GRADUATE COURSE IN OTOLARYNGOLOGY

The University of California Medical School announces that a postgraduate course in otorhinolaryngology will be offered Sept. 8 to 12, inclusive, 1947. The classes will be held daily, 8:30 to 11:30 a. m., and 1 to 5 p. m.

Requests for information and for registration are to be addressed to Dr. Stacy R. Mettier, head of postgraduate instruction, Medical Extension, University of California Medical Center, San Francisco 22.

Book Reviews

Pellagra in Otoneurology and Rhinolaryngology. By Otto L. E. DeRaadt, M.D. Price $5.90 (Dutch currency). Pp. 166. The Hague, Netherlands: N. V. Martinus Nijhoff, Lange Voorhout 9.

Dr. DeRaadt is to be congratulated on writing a fine monograph on pellagra as this is observed in the Japanese prisoner of war camps. That his accurate and detailed observations could have been made and recorded in such horrible surroundings is indeed remarkable.

The otoneurologic signs and symptoms which he noted are not generally associated with pellagra, which is usually thought of as a severe avitaminosis including the four D's, viz., diarrhea, dermatitis, delirium and death.

Among the most significant signs and symptoms were: nystagmus, vertigo, headache, Romberg's sign, weakness of convergence, tinnitus, some deafness, mydriasis and ataxia of convergence movements. The deficiency was felt to be one of multiple vitamins, chiefly of those in the B complex. Added symptoms were hypochlorhydria and achlorhydria, burning and pain in hands and feet, diarrhea, retrobulbar neuritis, perlèche and cheilosis, stomatitis, glossitis and pharyngitis.

Perhaps in some cases the so-called Ménière's symptom complex may likewise yield to the vitamin B complex and large doses of niacin (300 to 350 mg. per day). Also, perception deafness and tinnitus may yield to antipellagra treatment.

All in all, this study of 160 men, which was carried on under adverse conditions, is an admirable one and should lead otolaryngologists to be more observant of all persons who show otoneurologic and rhinoneurologic signs and symptoms, with the possible thought of subclinical pellagra or at least deficiencies of the vitamin B complex.

Directory of Otolaryngologic Societies *

INTERNATIONAL

First Pan-American Congress of Oto-Rhino-Laryngology and Bronchoesophagology

President: Dr. Gordon B. New, Mayo Clinic, Rochester, Minn.
Secretary: Dr. Chevalier L. Jackson, 255 S. 17th St., Philadelphia 3.

NATIONAL

American Medical Association, Scientific Assembly, Section on Laryngology, Otology and Rhinology

Chairman: Dr. J. Mackenzie Brown, 1136 W. 6th St., Los Angeles.
Secretary: Dr. Fletcher D. Woodward, 104 E. Market St., Charlottesville, Va.
Place: Atlantic City. Time: June 9-13, 1947.

American Academy of Ophthalmology and Otolaryngology

President: Dr. Alan C. Woods, Johns Hopkins Hospital, Baltimore 5.
President-Elect: Dr. C. H. McCaskey, 20 N. Meridian St., Indianapolis, Ind.
Executive Secretary-Treasurer: Dr. William L. Benedict, 100–1st Ave. Bldg., Rochester, Minn.
Place: Palmer House, Chicago. Time: Oct. 12-17, 1947.

American Broncho-Esophagological Association

President: Dr. Robert M. Lukens, Medical Arts Bldg., Philadelphia 2.
Secretary: Dr. Paul Holinger, 700 N. Michigan Ave., Chicago 11.
Place: Hotel Brighton, Atlantic City. Time: June 9, 1947.

American Laryngological Association

President: Dr. Frank R. Spencer, Physicians Bldg., Boulder, Colo.
Secretary: Dr. Arthur W. Proetz, Beaumont Bldg., St. Louis.

American Laryngological, Rhinological and Otological Society, Inc.

President: Dr. Harry W. Lyman, 906 Carleton Bldg., St. Louis.
Secretary: Dr. C. Stewart Nash, 708 Medical Arts Bldg., Rochester 7, N. Y.

SECTIONS:

Eastern.—Chairman: Dr. Robert F. Ridpath, 18th and Chestnut Sts., Philadelphia.
Southern.—Chairman: Dr. Walter T. Hotchkiss, 541 Lincoln Rd., Miami Beach, Fla.
Middle.—Chairman: Dr. Oliver E. Van Alyea, 135 S. La Salle St., Chicago.
Western.—Chairman: Dr. Colby Hall, 1136 W. 6th St., Los Angeles, Calif.

American Otological Society

President: Dr. William E. Grove, 324 E. Wisconsin Ave., Milwaukee, Wis.
Secretary: Dr. Gordon D. Hoople, 713 E. Genesee St., Syracuse, N. Y.

American Otorhinologic Society for the Advancement of Plastic and Reconstructive Surgery, Inc.

President: Dr. Alfred Schattner, 115 E. 61st St., New York.
Secretary: Dr. Norman N. Smith, 291 Whitney Ave., New Haven, Conn.

* Secretaries of societies are requested to furnish the information necessary to keep this list up to date.